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**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania:**  
AND  
**MECHANICS' REGISTER.**  
DEVOTED TO  
MECHANICAL AND PHYSICAL SCIENCE,  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
AMERICAN AND OTHER PATENTED INVENTIONS.

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EDITED  
BY THOMAS P. JONES, M. D.

MEMBER OF THE AMERICAN PHILOSOPHICAL SOCIETY, OF THE ACADEMY OF NAT-  
URAL SCIENCES, PHILADELPHIA, THE AMERICAN ACADEMY OF ARTS  
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NEW SERIES.  
  
VOL. XVII.

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*PHILADELPHIA:*  
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**PROSPECTUS**  
OF THE  
**JOURNAL OF THE FRANKLIN INSTITUTE,**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**  
DEVOTED TO  
**Mechanical and Physical Science,**  
**CIVIL ENGINEERING, ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**



EDITED BY THOMAS P. JONES, M. D. &c. &c.

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THE Committee on Publications avail themselves of the commencement of a new volume of this Journal, to address their patrons and the public in regard to the improvement and extension which it is proposed to make in the Journal.

These have reference to the requirements of Mechanics, of Civil Engineers, and of the scientific friends of the Journal, which have been made known to the Committee.

To designate fully their intention in the first particular, the additional title of Mechanics' Register will be assumed for the Journal, which will hereafter be designated as the Journal of the Franklin Institute of Pennsylvania, and Mechanics' Register.

The second and third will also be expressed in the title, the Journal being devoted to Mechanical and Physical Science, and to Civil Engineering, as well as to the Arts, Manufactures, &c.

It is the intention to distinguish the portions of the Journal in such a way, that each reader may find readily that which suits his taste or calling. While mechanical information will be diligently sought for as heretofore, and even elementary discussions invited the scientific reader will find that additional exertion is made in his behalf.

Besides the original matter connected with Mechanics, with Engineering, and with Physical Science, which may be obtained, general views of the progress of Theoretical and Practical Mechanics, of improvements at home or abroad, and of Physical Science, will be given by appropriate selections or abstracts from foreign or domestic transactions and journals. The Mechanics' Register will present the valued labours of the Editor in his list of American Patents with remarks, the specifications of patents, and the selections of foreign patents. Miscellaneous selections, or condensed statements of an interesting and useful character, will also be given under this head.

To provide for this enlarged plan of the work, the page will be increased both in breadth and length, and will contain one-sixth more matter than the pages of the previous volumes. Each number will contain, therefore, what will be equivalent to twelve additional pages. The volumes will, however, when bound, be of uniform size with the past volumes.

For the additional matter thus furnished it is not proposed to make any additional charge, and should mechanics or men of science extend further patronage, the means which will be thus furnished will be applied to extend the amount of matter in the journal, and to carry out more fully the plan which will now be attempted.

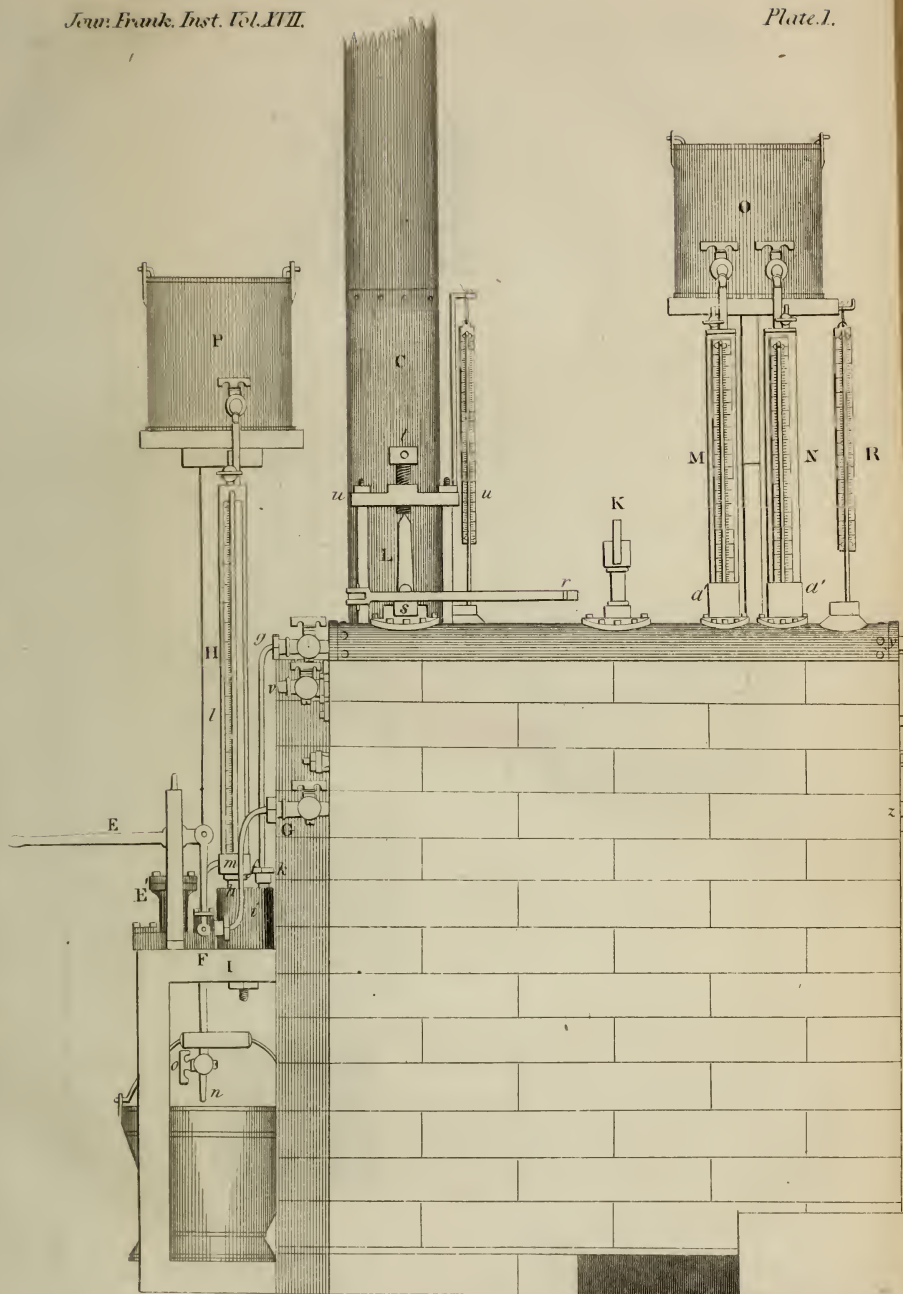
Not only will no extra charge be made, as just stated, but to subscribers out of the city the present charge for postage will be diminished by printing the work on medium and a half paper, by which means it will contain but three sheets to the number, instead of five, and the postage will be diminished one-third.

The Committee invite the contributions of Mechanics, of Civil Engineers, and of the votaries of General Science, to the pages of the journal. These will, when published, be liberally compensated, unless when special request is made to the contrary.

From the public the Committee respectfully solicit an increase of that patronage heretofore accorded. If each subscriber would endeavour to procure an additional one, he will enable the Committee to give a full development to their plans for the advancement of Science through the means of the Journal, and the original subscribers will thus receive benefit from their exertions.

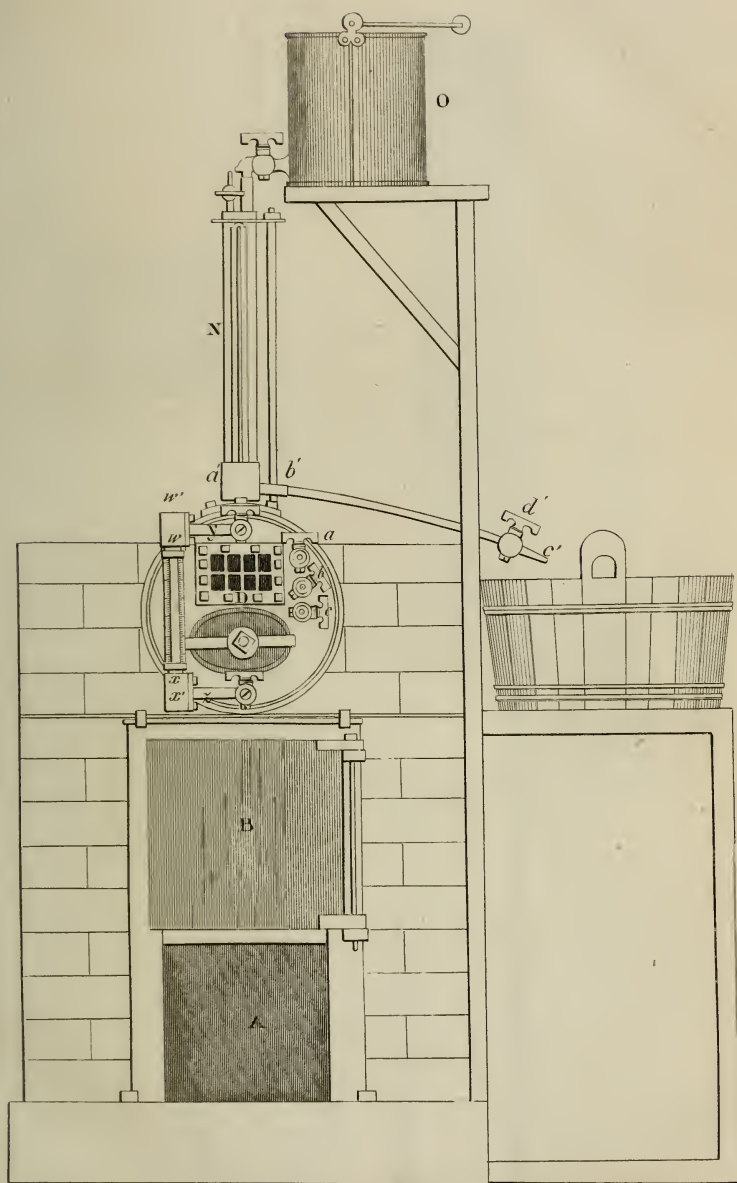
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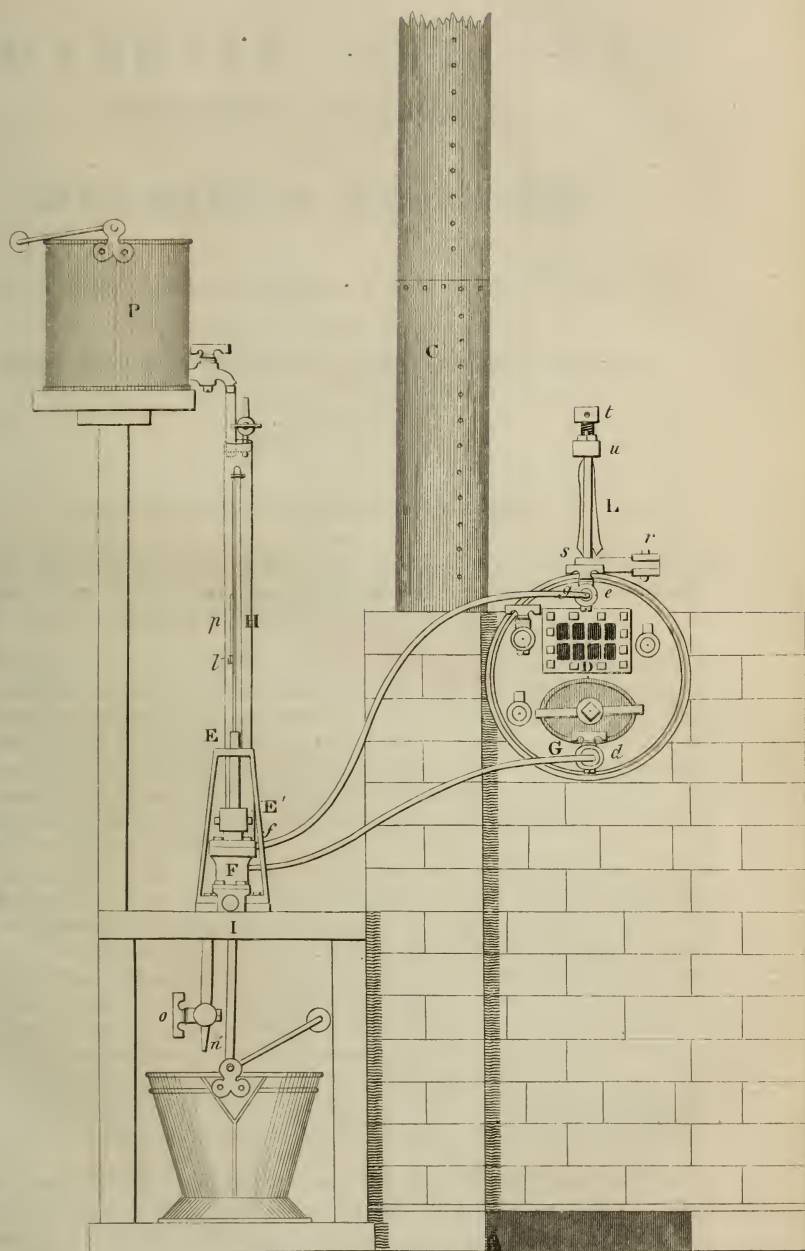
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# **JOURNAL**

OF THE

## **FRANKLIN INSTITUTE**

Of the State of Pennsylvania,

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### **MECHANICS REGISTER;**

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**JANUARY, 1836.**

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#### **Practical and Theoretical Mechanics.**

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*Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.*

THE Committee of the Franklin Institute on the Explosions of Steam-Boilers, respectfully present to the Secretary of the Treasury, their report of the experiments undertaken at the request of the department. The queries which were submitted by the committee, to the officer at whose request the experiments were instituted,\* have formed the basis of the labours of the committee. They have, however, availed themselves of the privilege accorded, of trying such other experiments as might grow out of the investigation, or as they might deem of special interest.

The object of the experiments was to test the truth or falsity of the various causes assigned for the explosions of steam-boilers, with a view to the remedies either proposed, or which may be consequent upon the result of the investigation. The causes being accurately known, the attention of ingenious men is led away from false suppositions, which can only waste their time and talent, if taken as the basis of their plans for safety; greater hope is afforded of an efficient remedy; applications of an indirect, or it may be of a positively injurious sort, are avoided; and if the causes be found to be such as for the present, to baffle ingenuity in their removal, the attention is directed more fixedly towards the means of protection against the effects of such accidents. The committee hope that the results of their inquiries will not be found without fruit.

It was the aim of the committee to provide for the experiments an apparatus of such dimensions as to furnish results applicable to practice, without being so great as to be managed with difficulty, or to increase, unnecessarily, the danger incident to parts of the investigation. To arrange the apparatus and complete the details, they secured the services of an able and experienced

\* The Hon. S. D. Ingham, late Secretary of the Treasury of the United States.

mechanic, David H. Mason, by whom, or under whose direction, the nicer parts of the work were executed, and who assisted, also, in the experiments.

The committee propose first to give a general description of the apparatus used, followed by details in the more complex parts; next to report the results of their examination upon each of the questions proposed for investigation.

## GENERAL DESCRIPTION OF THE APPARATUS.

The boiler used by the committee, and represented in Plates 1, 2, and 3, was twelve inches in interior diameter, two feet ten and a quarter inches in length within, and one-fourth of an inch thick; of rolled iron, with the heads rivetted in the usual manner. Plate 1 is a side view, and 2 and 3 are end views of the boiler, and of the apparatus connected therewith. The boiler was placed horizontally in a furnace, the fire surface extending about half way round the cylinder.

The furnace was arranged for a charcoal fire, the grate bars extending the whole length of the boiler, and the fire being applied through nearly the whole length. The draught entered by an opening, closed in the usual manner, and left the furnace through a flue placed at one end and side of the boiler. It will be convenient to use the terms fire end or front of the boiler, in reference to the proximity to the furnace door, and back end of the boiler. In Plate 2, A is the ash-pit door, B the furnace door, and in 1 and 3, C is the furnace chimney.

In order to examine, readily, the interior of the boiler during the progress of the experiments, each head was provided with a glass window, (D, Plates 2 and 3.) The glass used was three-eighths of an inch thick. The openings in the ends, which were rectangular, were two and a half by one and three-quarter inches wide. At first a glass plate, rather larger than the rectangle just mentioned, was applied to the opening, and kept in its place by four strips of brass secured to the heads, on which a rectangular frame, having the surface next to the glass accurately ground, was secured; the pressure of the steam keeping the glass against this frame, closed the boiler. Fractures occurring frequently from the rapidly varying, and often considerable, pressures within the boiler, and taking place by pressing the middle part outwards, as was proved by examining the fractures, frames with cross bars, see Plates 2 and 3, having the interior surface carefully ground, were used. The difficulty of properly adapting the surface of these frames to the glass having been removed, they were used in the later experiments, and were found to afford a sufficiently good view of the interior of the boiler, notwithstanding the obstruction by the cross bars.

Three gauge cocks were placed in the front head of the boiler; their positions will be particularly stated hereafter; they are shown in Plates 1 and 2, at *a*, *b*, and *c*.

To the same head and by the side of the gauge cocks, a glass water gauge (*w*, *x*, Plates 1 and 2) was attached, a particular description of which will be given in the detail of experiments made to compare its performance with that of the gauge cocks.

To supply the boiler with water, a forcing pump E E' F G, Plates 1 and 3, was placed near the back end. This pump was of the ordinary construction, with a solid plunger and conical valves; the diameter of the pump was one inch, and the play of the piston one inch and three-quarters. The diameter of the pipe, F G, by which the water was conveyed from the pump to the boiler, was three hundredths of an inch. By a coupling screw, this pipe could be connected with either of the stop cocks, *d*, *e*, Plate 3, in the back end of the boiler: the opening of these cocks was two hundredths of an inch in diameter.

To ascertain the elasticity of the steam within the boiler, a closed steam gauge (H, Plates 1 and 3) was used, a particular description of the construction, &c. of which will be given. This instrument was placed upon the same stand (I, Plates 1 and 3) which supported the pump, so that the same experimenter could observe its indications and attend to the working of the pump. The cistern of the gauge was connected by a flexible pipe, *f, g*, with the upper part of the boiler.

The safety valve is shown on the top of the boiler, (K, Plate 1,) midway between the heads. The graduation of it required much pains, and will receive a separate discussion.

Near the safety valve is represented at L, Plates 1 and 3, the fusible plate apparatus, consisting of a sliding plate of iron, moved by a lever. On the other side of the safety valve are the thermometers, M and N, Plate 1, plunged into iron tubes to give the temperature of the steam and water within the boiler. Above this appears the reservoir, O, containing the water intended to maintain the scales of the thermometers at a constant temperature. All these parts require a more detailed description.

## DETAILS OF THE APPARATUS.

### *Of the Steam Gauge.*

The steam gauge consisted of a glass tube closed at the upper, and open at the lower end, which passed steam-tight into a reservoir for mercury: when this reservoir was connected with the boiler the pressure of the steam raised the mercury into the gauge tube, compressing the air which the tube contained. The first mercurial gauge which was made was broken by a sudden access of surcharged steam, in the experiments upon that subject, and was replaced by a second one. The method of graduation, and in general the description of the second gauge, will serve also for the first; the details, only, varied slightly.

The glass gauge tube was 26.43 inches in length. To the lower end was connected an iron ferule, terminated above by a projecting ring. This ring was pressed upon the upper end of the pipe, *h*, Plate 1, by a coupling screw, which served to form a tight juncture between the gauge and the cistern. The cistern *i* was a cylindrical vessel of cast iron, having the two projecting tubes *h* and *k* upon which screws were cut; the first of them has been alluded to as giving a passage to the glass tube of the gauge; the second was coupled by the pipe *f, g*, Plates 1 and 3, to the boiler.

The gauge tube was not of precisely equal diameter throughout, and it was judged more accurate to graduate small portions of it into equal volumes. This was done by introducing equal measures of air from the point of a sliding-rod gas measure (Hare's); this operation was performed repeatedly, and by multiple measures to verify the results, until the marks made for the equal volumes, on a paper scale attached to the tube, coincided, in the various trials. The lengths of the spaces occupied by the equal volumes were then carefully measured upon the brass scale to be used with the gauge. The slight differences between the lengths given by adjacent parts of the tube, showed that it might be considered as divided into so many small portions of uniform diameter. The mercury rising into the gauge tube from the cistern when pressure is applied, the level of the cistern is necessarily depressed; the amount of the correction for this depends upon the relation between the areas of the cistern and tube, supposed uniform. The areas of the cistern were found to be, within the limits of its use, sensibly the same; those of the tube might be so assumed for such a purpose: the ratio was therefore found by filling the gauge tube with mercury, and pouring this into the cistern, noting the rise produced; comparing this with the mean length of the tube, the ratio of depression in the gauge for elevation in the tube was found to be as .01 to 1. The air within

the tube was next carefully dried by the introduction of a receptacle of chloride of calcium, of the same length with the tube;\* the air having been in contact with this substance for a sufficient time, the receptacle was withdrawn through the mercury over which the drying had been effected; the tube was next placed over a dish of mercury, in the receiver of an air pump, and the air withdrawn until on re-admitting air to the receiver, the mercury rose in the tube above the iron ferule.

The gauge tube was next introduced into the cistern, the level of which corresponding to the zero of the brass scale was then arranged, and the point of the scale at which the mercury stood was ascertained, the barometer and thermometer being noted.

It was intended in the experiments to keep the pipe from the gauge to the boiler cool, so that it might contain water, and thus give a nearly constant pressure upon the mercury of the cistern,† besides preventing the exposure of the apparatus to heat; the height of this column, above the level of the cistern, was therefore ascertained, after the gauge was put in place by screwing the cistern *i* to the stand.

All the elements for calculating the elasticity of the steam within the boiler, from the height of the mercury of the gauge, were thus known; the temperature of the apparatus being supposed constant.

The elastic force of the steam within the boiler, together with the column of water in the steam pipe, balances the elasticity of the compressed air within the gauge, together with the column of mercury above the level of that in the cistern. This level is not the original zero, but lower than that by the depression produced by the rise of mercury in the gauge tube. The depression of the mercury changes the level above which the pressure of the column of water in the steam-pipe, is measured, but the change in the pressure, by the column of water, is altogether inconsiderable. The law of the elastic force of dry air, which has been recently shown, by Dulong and Arago, to be accurate, at pressures from one to fifty atmospheres, was made use of in determining the elasticity of the air in the gauge: this elasticity is inversely as the space occupied by the air. From the data already obtained and upon the principles just stated, a table was calculated by which the observed heights of the gauge were converted into the corresponding pressures in inches of mercury or in atmospheres. The calculations were rendered rather tedious by the unequal diameter of the bore of the tube, on account of which equal lengths did not correspond to equal volumes. The usual method of calculation was resorted to, namely, to determine, by rigid calculation, the pressures, for points sufficiently near each other, and then to interpolate for intermediate heights.

The foregoing remarks take for granted that the temperature of the air in the gauge, as well as that of the mercury, remains constant; to secure this, an arrangement was adopted similar to that employed by Dulong and Arago for the same purpose. The gauge and scale were surrounded by a glass tube, *l*, Plates 1 and 3, cemented below into a brass cap, *m*, Plate 1, which had an opening in the side, communicating with a discharge pipe, *n*, Plates 1 and 3. The tube was attached above by an air-tight juncture to a tin vessel, *P*, of considerable capacity, compared with the tube. Water being introduced into the glass tube surrounding the gauge, the flow through this tube was regulated by

\* By this method, each volume of air in the tube was in contact with nearly a twelfth of its bulk of the chloride.

† This and very many of the other precautions to insure accuracy, are borrowed from the able memoir of Dulong and Arago on the elastic force of steam at different temperatures; the result of their labours, as members of a Committee of the French Academy. Those who have engaged in questions of research will know that too great care cannot be taken to prevent the introduction of error, even in researches where great nicety may not be considered essential.

a stop-cock, *o*, placed at the end of the discharge pipe, the cistern above being filled with water.

To ascertain the temperature of the column of water surrounding the gauge, a thermometer, *p*, Plate 3, with a very small bulb was attached to the scale at the middle of its height: by this instrument, the flow of water through the casing of the gauge was regulated so as to keep the temperature nearly constant, and any deviations from a constant temperature were ascertained and noted, that the proper correction might be applied. The correction for the expansion of the air in the gauge, by a rise in its temperature during the progress of the experiments, was made according to the rules furnished by the rate of expansion of the gases, as determined by Gay Lussac, extended to compressed air by the experiments of Davy.\* The correction for the changes of height of the mercurial column, within the range to which the temperature was suffered to increase, could not have been appreciable if acting entirely, and the counteracting effect of the expansion of the glass, further justified its being neglected. For similar reasons no reference was made to the effects of heat on the mercury in the cistern, *i*, on the cistern itself, and on the water within the pipe communicating with the boiler.

### On the Thermometers.

In most of the researches of the committee, refinements in the mode of using the common thermometer would have been out of place. Results which might be obtained with little additional labour, and which would be interesting in both a practical and scientific point of view, were not to be neglected, and

\* Let *e* represent the elastic force of the air within the gauge tube, expressed in inches of mercury; let *h* be the height of the mercurial column above the original zero; *h'*, the height of the column above the new level; *a*, the height of the column of water in the steam pipe above the zero; *s*, the specific gravity of mercury; *t*, the tension of the steam within the boiler, in inches of mercury. Then *h'—h* is the depression in the cistern caused by the rise of mercury in the gauge, and *a+h'—h*, the height of the column of water in the steam pipe above the new level in the cistern. We have then,

$$e + h + h' - h - \frac{a + h' - h}{s} = t$$

For the gauge in question, *h'—h* = .01 *h*, *a* = 17.5 inches, also *s* = 13.6; then

$$e + 1.01 h - \frac{17.5}{13.6} - \frac{.01 h}{13.6} = t, \text{ or } e + 1.01 h - 1.29 - .0007 h = t;$$

the term .0007 *h* may be neglected as inconsiderable, since for *h* = 24 inches, this term is only .0163. The equation then stands,

$$e + 1.01 h - 1.29 = t.$$

At the temperature of 48°, and at a mean pressure, the observed value of *h* was 3.23; of course, *e* = 26.77. The volume of the air in the gauge was 8.63.

To find the elasticity for any other height, *h'*, find from the data relating to the volume of the air in the gauge, the new volume; call this *v'*, and the elasticity due to it *e'*; then:—

$$v : 8.63 :: 26.77 : e'; \text{ and } e' + 1.01 h' - 1.29 = t.$$

To introduce the correction for temperature, since the elasticity produced by an increase of temperature corresponds with the expansion produced, and since the expansion of condensed air follows the same law as that of air of ordinary density, expanding  $\frac{1}{480}$ th of its bulk at 32°, for each additional degree of Fahr. above this point, or  $\frac{1}{96}$ th of its bulk at 48°; calling *e'* the elastic force of the heated air, *e'* that of the same air at 48°, *n* being the number of degrees of heat above 48°.

$$e' = e + \frac{n e'}{496} = e' (1 + .002 n)$$

whence, since  $e' = \frac{8.63 \times 26.77}{v'}$ ,

$$\frac{231.02}{v'} (1 + .002 n) + 1.01 h' - 1.29 = t.$$

to some of them great accuracy was essential. In the questions of the first class the thermometers were provided with wooden scales, and were graduated by immersion up to the point at which the scale commenced, the scale and upper part of the tube being exposed to the air; this was proper, as they were intended to be immersed in mercury nearly up to the scale. These instruments were examined after coming from the makers' hands, and the instrumental error ascertained. The tubes in which the thermometers were placed, and which contained mercury, were at first placed horizontally in one of the heads of the boiler; this had the advantage of rendering the tube for indicating the temperature of the water entirely independent of the steam, and thus any difference between the temperature of one and the other might be more effectually ascertained, than when the tube giving the temperature of the water passed through the steam. The position of these instruments interfered so much with other parts of the apparatus, and so much inconvenience and danger of error was experienced from the separation of the column of mercury in the thermometer, that these tubes were not used after the first weeks of experiment, and two vertical tubes, placed as already shown, were substituted for them.

The thermometers used, when the relation between the temperature of the steam and water, and the elasticity of the steam were to be observed in conjunction with some of the subjects more directly under the cognizance of the committee, had much pains bestowed upon them.

The scales (M and N, Plate 1,\*) were metallic, and surrounded by glass tubes, fitting into a cup, *a'*, through the bottom of which the stem of the thermometer passed water tight; a pipe, *b' c'*, Plate 2, from the side of each cup, and provided with a stop-cock, *d'*, regulated the flow of water through the enveloping tubes: a tight connexion above, with a reservoir, (O, Plates 1 and 3,) served, as in the case of the gauge, to supply the tubes with water. Small thermometers on the back of the scale of the large ones, showed the temperature of the water which surrounded them. The enveloping tubes being filled with water at 60°, the position of the boiling point of water and of the fusing point of tin, were used to verify the accuracy of graduation. The latter point, which is high upon the scale of the thermometer, having been very accurately determined, and being easily and with certainty ascertainable, serves as an excellent check upon the graduation. The greatest error within the limits just stated, was, in one instrument, three-fourths of a degree, and in the other one degree of Fahrenheit. The scales were graduated from two to two degrees, one quarter of a degree being readily estimated upon them. The corrections required by this examination were made through the medium of a table prepared for the purpose. In order to call the attention to the temperature of the water surrounding the scales, this temperature was recorded from time to time, when the height of the thermometers was observed. At no time did the rise of temperature, permitted in the water, make it necessary to apply a correction for the expansion of the scale.† None was required for the cooling effect of the water around the stem upon the mercury, owing to the method of verifying the scale.

The other parts of the apparatus, less general in their use, as the water gauge, safety valve, fusible plate apparatus, &c., will be more conveniently described in connexion with the experiments for which they were devised.

\* In Plate 2, thermometer N, to render it conspicuous, is shown, as if the scale were turned to the front of the boiler.

† Upon the scale of one of these instruments there were 314° in 6 inches. Brass expands  $\frac{1}{333}$ ds of its length, from 32° to 212°. These 6 inches, at 32°, would become 6.0113 at 212°. Ten degrees upon the scale would become 9.99 by a variation of temperature from 32 to 212°, a diminution of only .01 of a degree for a variation of 180° in the temperature of the scale. In practice, the variation never exceeded thirty degrees.

## SUBJECTS OF INVESTIGATION.

The queries originally proposed, together with the new matters, which were made the subjects of experiment, will be treated in the following order.

I. To ascertain whether, on relieving water heated to, or above, the boiling point from pressure, any commotion is produced in the fluid.

Including the examination of the efficacy of the common gauge-cocks, of the glass gauge, and of Ewbank's proposed gauge-cocks.

The investigation of the question whether the elasticity of steam within a boiler may be increased by the projection of foam upon the heated sides, more than it is diminished by the opening made.

II. To repeat the experiments of Klaproth on the conversion of water into steam by highly heated metal, and to make others, calculated to show whether, under any circumstances, intensely heated metal can produce, suddenly, great quantities of highly elastic steam.

First, The direct experiment in relation to the production of highly elastic steam in a boiler heated to a high temperature.

Not to interrupt the general train of investigation which follows a well known theory of explosions of steam boilers, the results of the experiments on the former part of this query, are inserted in another place.

III. To ascertain whether intensely heated and unsaturated steam can, by the projection of water into it, produce highly elastic vapour.

IV. When steam, surcharged with heat is produced in a boiler, and is in contact with water, does it remain surcharged, or change its density and temperature?

V. To test, by experiment, the efficacy of plates, &c., of fusible metal, as a means of preventing the undue heating of a boiler, or its contents.

1. Ordinary fusible plates and plugs.
2. Fusible metal, inclosed in tubes.
3. Tables of the fusing points of certain alloys.

VI. To repeat the experiments of Klaproth, &c.

1. Temperature of maximum vaporization for copper and iron under different circumstances.
2. The extension to practice, by the introduction of different quantities of water, under different circumstances of the metals.

VII. To determine, by actual experiment, whether any permanently elastic fluids are produced within a boiler when the metal becomes intensely heated.

VIII. To observe accurately the sort of bursting produced by a gradual increase of pressure, within cylinders of iron and copper.

IX. To repeat Perkins' experiment, and ascertain whether the repulsion stated by him to exist between the particles of intensely heated iron and steam be general, and to measure, if possible, the extent of this repulsion, with a view to determine the influence it may have on safety valves.

X. To ascertain whether cases may really occur when the safety valve, loaded with a certain weight, remains stationary, while the confined steam ac-

quires a higher elastic force than that which would, from calculation, appear necessary to overcome the weight on the valve.

XI. To ascertain by experiment the effect of deposits in boilers.

XII. Investigation of the relation of the temperature and pressure of steam, at ordinary working pressures.

Table from 1 to 10 atmospheres.

*I. To ascertain, by direct experiment, whether on relieving water heated to, or above, the boiling point, from pressure, any commotion is produced in the fluid.*

The first experiments on the effect of relieving water in ebullition from pressure, were made in a glass boiler; here the fire was under the whole length of the boiler, which was a cylinder of fourteen and a quarter inches in length, and seven and a half inches in diameter. The steam within, being at a pressure of less than two atmospheres, by opening a cock at the end of the boiler, or the safety valve, also at the end, large bubbles were formed through the whole extent of the boiler.

The inquiry was prosecuted in the iron boiler already described, a distinct view of the interior being had through the glass windows placed in the heads. The greatest intensity of the fire was in front of the middle of the boiler, and extended through about one-third of its length: the part immediately near the flue, was next to this band in temperature. With this boiler experiments were made, which showed, that on making an opening in the boiler, even when the pressure did not exceed two atmospheres, a local foaming commenced at the point of escape, followed soon by a general foaming throughout the boiler, the more violent in proportion as the opening was increased. This small boiler was completely filled with foam by opening the safety valve, (nearly two-tenths of an inch in area) which was placed on the middle of the top, and the water violently discharged through the opening of the valve. The area of the valve bears to the horizontal section of the boiler, at the water line, the ratio of one to two thousand and fifty-five nearly.

The boiler was half full of water in these experiments. The gauge fell always on making the opening.

The foaming, which was so repeatedly observed, must be produced in a greater or less degree every time that steam is drawn from a boiler to supply the engine; every time that a gauge-cock is opened, or the safety valve raised. It is interesting in two points of view; first, in its effects upon the apparatus designed to show the level of the water within the boiler; second, by its throwing the water against the heated sides of the boiler.

### *Gauge-cocks and Glass Water-gauge.*

The apparatus most commonly used in our country for determining the level of the water within a boiler, consists of three gauge-cocks attached to the boiler head, one of them being at the water level, and the others equally distant above and below that level.

These cocks in the experimental boiler, *a, b, c*, Plates 1 and 2, were 1.95 inches and 1.8 inches apart, measuring from the centre of the opening of the middle one, to the one above and to the one below.

The steam in the boiler being not higher than two atmospheres, the following experiment was made. The level of the water was reduced until it stood just below the lowest gauge-cock. On opening this cock, steam at first flowed out, then water and steam; on opening the second cock, in addition, water flowed freely from the lowest, which was above the hydrostatic level; the

foaming within the boiler, which was produced by thus relieving the pressure, was distinctly seen through the glass windows. On opening the third cock, steam and water issued from the second, which was two inches above the water level; and on partially raising the safety valve, water flowed freely from the second cock. A further rise of the valve filled the boiler with foam, water flowed freely out of the third cock, more than three inches and three-quarters above the water level, and finally through the opening of the safety valve itself. In these experiments, an opening of .03 of a square inch in area, the lowest cock, which, to the area of the water surface, was as one to thirteen thousand seven hundred, caused water and steam to issue through a cock, below which the water was known to be. A further opening of .03 of a square inch, making, with the first, .06 inch, or one six thousand eight hundred and fiftieth the area of the water surface, brought water from the lowest cock; a total opening of .09 inch, ( $\frac{1}{13567}$ th of the area of the water surface) brought water and steam from the middle cock, indicating that the level of the water was nearly two inches higher than it really was.

A first apparatus, which was contrived for applying fusible plates to the boiler, suddenly opened an aperture of .95ths of an inch in diameter. Even at low pressures, the scalding contents of the boiler were violently discharged, through this opening, against the roof of the experiment house.

It is time now to speak of the glass gauge-tube, as a means of indicating the level of the water within a boiler, in connexion with which an experiment bearing upon the performance of the gauge-cocks will be stated.

The form given to the water gauge, on its first trials, was that described to the committee by Mr. Hartshorne, of Cincinnati. This was a prismatic box of brass, of suitable dimensions; one face of which was supplied by a glass plate; this box, being put in communication with the boiler, by two pipes, one entering from the steam, the other from the water, the level of the water was seen through the glass plate. This apparatus was attached to the experimental boiler, and its indications compared with those of the gauge-cocks in the experiments already detailed. On relieving the water from pressure, the water within the gauge was agitated; during the further foaming its oscillations did not amount to half an inch, so that the hydrostatic level was truly shown by it; and further, on closing the openings, the fluid in the gauge became tranquil at the mean level of its oscillations, showing that it had fallen with the fall of the water within, caused by the escape of steam. An instructive experiment to the same purport was made on the occasion of a fracture in one of the glass windows, described as placed in the ends of the boiler. The account taken from the minutes of the day's experiments is as follows:

The temperature being at 292° F., and the pressure indicated by the gauge four atmospheres, the north window of the boiler, which had a flaw in it, cracked across the middle, and nearly horizontally; steam issued slowly through the crack; on looking into the boiler a foaming at the end where the steam was escaping was observed. The crack rapidly enlarging, the steam issued in quantities through it; the water was in general agitation throughout the boiler, running out at the crack, though its hydrostatic level was at the bottom of the window, about one inch and a quarter below the crack, and being distinctly seen at the opposite window, foaming near the top of the glass; the water-level gauge began to fall, oscillating not half an inch in its fall. The safety valve was now opened by hand, so as to waste the water with great rapidity. The water still issued through the crack, the water-level gauge falling. On closing the valve the water settled down, becoming comparatively tranquil; the water gauge remained at the same level: it had, therefore, indicated constantly the true level unaffected by the foaming, except in slight oscillations.

In fact, this gauge shows truly the height of the water within the boiler, until the foam rises so high as to pour over through the upper connecting tube.

The idea was suggested that by placing the gauge-cocks in a prism, connected above with the steam, and below with the water in the boiler, the true level of the water would be indicated. Such a cock was, therefore, applied to the box of the water gauge; its opening produced a local foaming in the gauge, which brought water through the cock, although the true level was much below it. The area of this cock was nearly equal to the area of that which opened into the steam chamber of the boiler.

In relation to the form of the water gauge, as already described, it does not seem to offer as many advantages as the tube which has been adapted to the boilers of some of the English locomotive engines.\* The glass plate requires the support of horizontal bars, which are objectionable, or it must be reduced so much in breadth that the level is obscurely seen through it; the strain upon the plate being unequal, it is very liable to fracture; such fractures repeatedly took place near the centre of the plates in the gauge used by the committee.

To the use of the glass gauge for the high pressure engine, an objection occurs, from the effect produced by high steam upon the glass, apparently by its action on the alkali; by which the transparency of the glass is gradually destroyed. A similar effect was recorded by Cagniard de Latour, in his experiments on liquids at high temperatures, confined in glass tubes.† As far as the experiments of the committee have gone they show that green glass is not so readily injured; and as it is easily procured in tubes, a further reason appears for preferring the tube, in practice, to the plate.

An attempt which was made to substitute windows of mica in the boiler for those of glass, bears upon the use of that mineral for the plate of the water gauge; as does also another attempt which was made to protect the glass plates by a lamina of that mineral. The mica exfoliated under the action of the steam which insinuated itself between the laminæ through cracks which were invisible, if existing, before the experiment, or which may have been produced by the steam itself; the laminæ were separated, and thus the steam quickly found a more or less direct passage through the plate.

The tube gauge which was substituted for the prism is shown in Plates 1 and 2.  $w x$  is the tube of green glass passing into the stuffing boxes,  $w'$  and  $x'$ ; the stuffing enables an adjustment to be made for the unequal expansion of the glass and metal by heat, and prevents fracture on the subsequent cooling of the apparatus.  $y$  and  $z$ , Plate 1, are passages connecting the tube with the boiler; these have conical terminations, by which the pipe is readily attached to, and detached from, the tubes  $y$  and  $z$ , which are screwed into the boiler, and are provided with stop-cocks: coupling screws might, in practice, be substituted for these conical terminations. To protect the tube,  $w x$ , from currents of air, it was surrounded by a second tube, loosely applied. A scale was attached to  $w x$ , to indicate the level of the water within the boiler. The tube being transparent, shows the level of the water more readily than it can be seen in the prism before referred to, which was opaque on three of the vertical sides.

The gauge used was nine inches and three-quarters in length. The upper part being so near the top of the boiler as only to be affected by the foaming, in extreme cases; the lower part so near to the bottom that the level of the water was indicated, unless when very low indeed.

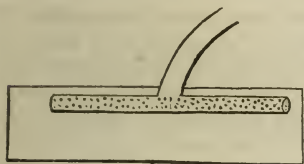
The position of the lower communication of the gauge with the boiler soon

\* The application of such a gauge to a locomotive engine can give but little idea of its use for a stationary engine. The jarring in the locomotive must constantly expose the gauge to fracture, and perhaps may prevent its use. The glass water gauge has been adopted in at least one of the boats plying between New York and Amboy, New Jersey, belonging to Messrs. Stevens; and the committee understands, are also in use upon their locomotive engines.

† See also recent experiments on the action of water at high temperatures upon glass, by Professor Turner, of the University of London. Royal Society's Trans. for 1834.

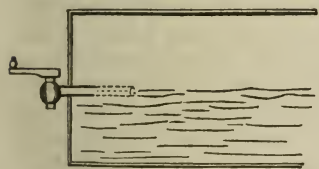
showed a defect, to which the instrument must be always more or less liable, namely, to the obstruction of the lower passage by sediment. To remedy this, a stop-cock was attached to the lower part of the gauge, as at  $x'$ , Plate 1, and through it, when open, water could be blown, by the pressure of the steam in the boiler, so as to remove any obstruction. This method is to be preferred to that of closing the upper communication with the boiler, while the lower one remains open; in which case the sediment is driven up into the glass tube, soiling it, accumulating there, and affording only a temporary remedy. When the obstruction in the pipe is not removed on opening the cock, a wire inserted will effectually clear the passage.

In connexion with this subject the committee experimented upon the method proposed by Mr. Thomas Ewbank, of New York, for lessening or preventing the foaming here stated to occur. The remarks of Mr. Ewbank are to the following effect: "When steam is raised in a boiler, and the engine not working, the water within (if the flues are sufficiently covered) is probably on a level and nearly at rest; but as soon as the steam is admitted into the cylinder, it causes an ebullition of the water, which rises towards the mouth of the steam pipe, in consequence of the portion of the pressure upon it being suddenly removed at every stroke of the piston. This might, I think, be prevented by continuing the steam pipe an inch or two into the boiler, and then branching it off towards each end of it, with small apertures in its sides and ends, as in



"the diagram. In this manner, the steam would be equally withdrawn from every part of a boiler, instead of being violently agitated in rushing to one place. Such a tube attached to the aperture of a safety-valve, would be equally advantageous; or the valve might be placed on one end of the tube leading to the cylinder.\*

"The inaccuracy of the common gauge-cock as a means of detecting the true height of the water in a boiler, arises chiefly from two causes; firstly, from the agitation of the water while steam is being withdrawn from the boiler to supply the engine, or through the safety valve: and secondly, from the current or rush of steam produced towards the aperture of a gauge-cock when it is open; in consequence of which the water, though previously at rest, is agitated and carried out through it.



"various directions." "The next figure shows a method by which both the defects to which I have alluded as affecting the gauge-cock, may be remedied.



"The cock passes through the head of the boiler in the usual way, and is then united to a perpendicular pipe, open at both ends, and about two or three inches in diameter. The lower end of the pipe is four or five inches below the surface of the water, and its upper end is carried as far above the level as may

"be convenient." "When this cock is opened no current can be formed in

\* Journal of the Franklin Institute, vol. 9, p. 366, 1832, letter from Thos. Ewbank, Esq. of New York, to the Com. on Explosions.

“the direction of its aperture, and the water in the tube P (which will of course “be at the general level of the water in the boiler,) will not be so subject to “agitation\*.”

To test the idea that the foam which issues through the gauge-cock is produced by a rush of steam towards the aperture, and the method, proposed by Mr. Ewbank, for lessening it, tin pipes, ten inches and three-eighths in length, and three-eighths of an inch in diameter, with seventy-nine perforations, each about two hundredths of an inch in diameter, were attached to the central and lowest gauge-cocks *b* and *c*, Plate 1. When the level of the water within was about five-eighths of an inch below the cock *c*, or nearly two inches and four-tenths below the cock *b*, on opening the lowest cock, the steam being at a pressure of two atmospheres and two-tenths, a very little water mixed with the steam, passed through the opening of the cock; on opening the middle cock *b*, water and steam flowed through *c*; on closing this and opening the highest cock *a*, less water issued through *c*. When both *a* and *b* were opened, the water flowed copiously through *c*. At the close of this experiment, the glass water-gauge showed that the level of the water within the boiler was one inch below the lowest cock.

In another experiment the water being one inch and a half below the lowest cock; *c* being opened, no water issued; *c* and *b* being opened, a very little water issued through *c*; *a*, *b* and *c*, being opened, a little water was mixed with the steam.

The facts thus elicited, are in accordance with the preceding observations of the committee in relation to the general foaming which takes place when an aperture is made in any part of the boiler. The great respect which they entertain for the ingenious author of this device, on account of the valuable contributions which he has made to them, induced them to give this full trial of his suggestion.

The third form of apparatus would cut off the access of water from the general foaming, until it reached the level of the lowest apertures; but it would substitute a local foaming which would effectually, if not equally, prevent the true hydrostatic level from being indicated: in this respect it is nearly equivalent to the gauge-cock, already described, as applied to the water-gauge.

### *Alarm Floats.*

The various floats which have been applied to show the level of the water within a boiler are well known. They have never obtained favour in this country, and are considered particularly objectionable in their application to the high pressure boiler, on account of the motion within. The stuffing-box, commonly used to pass the index-rod of the float through the top of the boiler, is objectionable, and different devices have been originated with a view to remedy this difficulty. That of Mr. Thomas Ewbank, of New York, described in volume 16, of the Journal of the Franklin Institute, is highly ingenious, and is reported by him to have stood the test of experience in his small boiler, producing steam of rather less than five atmospheres. The apparatus of the committee did not furnish facilities for a proper trial of this float; and besides, such a trial would be inadequate to test its use in practice.

A float serving to give an alarm by the issuing of steam, was made the subject of a few experiments, and answered well, as far as those trials went. Long use, however, could alone determine, perfectly, the peculiar liabilities to derangement in this apparatus. The float alluded to is shown on Plate 4, fig.

\* Journal of the Franklin Institute, vol. 10, pp. 80, 81, 1832. “Supplement to the communication of Thomas Ewbank, Esq. of New York, to the Com. on Explosions.”

A. The requisite buoyancy is given to the metallic pyramid, *a*, which is solid, by the weight *b*, acting as a counterpoise over the fulcrum *c*. The whole apparatus is attached to the top of the boiler by the screw *d*, and the nut *e*, and the working parts are thus entirely within the boiler. When the water is at the proper level *f g*, the shoulders *h* and *i* are in the same horizontal line, and the disks *k l*, which are pressed against the shoulders by two springs shown in the figure, close the apertures *k m*, and *l n*, which, when open, permit steam to escape from the boiler. Should the water sink below its proper level, the equilibrium of the pyramid *a*, being destroyed, the shoulder *i*, would press against the disk *l*, remove it from the aperture, and permit steam to escape through *l n*; should the water, on the contrary, rise above the proper level, steam would escape through *k m*. The force of the springs which close these openings, should, of course, be duly proportioned, as they will determine the sensibility of the apparatus. The details of construction are clearly shown in the figure, which is drawn to a scale.\*

The quantity of steam which would escape by the small opening *l n*, while it would serve as an alarm, would not materially diminish the supply of water within the boiler. The float used by the committee, was found to be sensible to less than three-tenths of an inch in the change of level: it could have been made more sensitive by increasing the breadth between the shoulders, so as to bring them in contact with the disks, as shown in the figure.

### *Effect of Foaming on the Elasticity of the Steam within the Boiler.*

This point was the next proposed for examination. When an opening is made in a boiler, of which the sides are heated, will the effect be to diminish the elasticity of the steam within, by permitting its escape, or will the water thrown upon the heated sides by the foaming which results, be converted so rapidly into steam as actually to increase the elasticity of the vapour within? It is obviously difficult to obtain an answer to a query involving so many conditions. It might be expected, however, that a small boiler would afford satisfactory means of making a fair trial of the question, since the size of the openings could be varied very easily, so as to make them comparatively small, or very great. The position of the boiler used by the committee in its furnace was such, that the sides could be very readily heated; thus placing it in favourable circumstances to increase the elasticity of the steam by producing a foaming within. The apparatus was therefore adapted to make the desired trial.

M. Arago, in his Essay on the Explosions of Steam-Boilers, states, that MM. Tabareau and Rey, at Lyons, found on opening a large stop-cock, connected with a small high pressure boiler, that the safety valve rose, showing an increase of pressure within. The boiler was placed naked upon a fire of charcoal, and the part not containing water was surrounded by flame. The experiments of MM. Arago and Dulong, at Paris, were attended with a contrary result, the opening of a safety valve being always accompanied by a diminution in the elasticity of the steam within. The circumstances, however, were not the same as those in the experiment of MM. Tabareau and Rey.

To repeat this experiment, a hot fire was made beneath the boiler, and when the water had fallen to about three inches above the lowest line of the cylinder, the experiment was commenced, the pressure being about three atmospheres and a half. A stop-cock of .03 sq. inches in area,  $\frac{1}{10966}$ th part of the area of the water surface at the beginning of the experiment, delivering per second, at three

\* In the figure, the shoulders *h* and *i*, do not rise high enough; they should overlap the disks more, that no depression or elevation of the water may carry them clear of the disks.

and a half atmospheres, about four hundred and nine cubic inches of steam was first opened; next the safety valve was raised, either in part or entirely, the area when entirely raised, being .208 sq. inches, or  $\frac{1}{500}$ ths of the water surface, and capable of delivering, in one second, at three and a half atmospheres, a bulk of steam nearly nine times that of the steam chamber. The water level falling by the waste caused in the experiments, the steam soon became surcharged with heat; and the iron of the boiler, from near the water line to more than one-third of the distance from the lowest line to the middle of the convex surface, became, on each side of the water line, heated until it attained redness, passing, of course, through the temperature of maximum vaporization of the water thrown by the foaming, upon the iron. The experiments were made at intervals, until all the water was exhausted. Water was then injected in small quantities, and with the bottom of the boiler for the most part red hot, the trials were repeated.

It will be seen from the following table, that the result was uniformly a diminished elasticity of the steam within, as shown by the fall of the mercury in the steam gauge. The pressures varied, in the former part of the experiments, from three and a half to eight atmospheres.

The first column of the table contains remarks referring to the level of the water within the boiler. The second to the opening made. The third is the temperature indicated by the thermometer, M, Plate 1, before referred to, as passing nearly to the bottom of the boiler. The fourth, the height of the mercury gauge, before making the opening. The fifth, the height immediately after making the opening, unless the contrary is stated in the sixth column, which contains remarks relating to the effect on the gauge. The seventh column contains general remarks.

The thermometer at first indicated the temperature of the water, then that of the surcharged steam, and finally was affected by the heat radiated from the bottom of the boiler.

Remarks on Depth of Water.	Nature of Opening.	Temp. by long Ther.	Height of Steam Gauge.		Remarks on the Depression of the Steam Gauge.	General Remarks.
			Before.	After.		
		Fah. °	Inches.	Inches.		
3 inches,	Gauge-cock,	234½	18.6	18.0		Temperature of air in gauge, 80°. Pressure corresponding to 18.6 inches, 3½ atmospheres.
	Do.		20.4	20.2		
	Safety valve,		20.5	20.0	Fall very rapid.	
	Gauge-cock,		21.0	20.9	Fall immediate.	
	Safety valve,		21.3	21.0		Pressure corresponding to 21.3 inches, 5½ atmos.
.9 of an inch,	Gauge-cock,	317½	21.9	21.8		
	Safety valve,		22.1	21.7	Fall in ½ second.	
	Do.		22.6	20.6	Fall in 2 seconds.	From about 8½ to 5 atmospheres. Steam surcharg'd, bottom rapidly increasing in heat.
.9 inch nearly,	Stop-cock,	380			Falls.	
	Safety valve,	468½	15.1	12.6		
	Gauge-cock,		18.0	14.0		Water exhausted, supply thrown in. Thermometer rose to 600°.
	Safety valve,		16.0	14.0	Sudden descent.	

*II. To repeat the experiments of Klaproth relating to the conversion of water into steam, by highly heated metal, and to make others calculated to show whether, under any circumstances, intensely heated metal can produce, suddenly, great quantities of highly elastic steam:—*

The first part of this query relates to the repetition and extension of the experiments of Klaproth, the second has reference to them, but may be determined by direct experiment, independently of the methods required for obtaining an answer to the first part of the query. It has been supposed that because the metal of a boiler was heated above the temperature at which the metal would produce steam most rapidly, it was impossible to account for the production of quantities of highly elastic steam, by such a cause. The committee, determined to make the fact of the production of high steam by intensely heated metal the subject of a direct experiment, and under circumstances as nearly similar as possible to those which may occur in a boiler, of which some parts, as the sides or interior flues, may become unduly heated, when not in contact with water.

The experimental boiler being arranged as already described, a small quantity of water was placed in it and boiled away; the heat being still applied, the temperature of the bottom was gradually raised. At different temperatures of the bottom, water was thrown in by the forcing pump, and the effect of a given quantity, on the gauge, noted. The temperature of the steam generated, was ascertained by a thermometer passing horizontally through the back head *g*, Plate 1, and two-thirds of the diameter above the bottom of the boiler: a second horizontal thermometer as near to the bottom as the rim of the boiler would permit, served to show whether the heat was rising or falling, and was noted for this purpose. Both the windows of the boiler had glass  $\frac{3}{8}$ ths of an inch thick in them, without the cross bar covering. The water injected was at 70° Fah. The course of the water injected could be distinctly marked after the bottom of the boiler had become heated to redness, and was examined through the glass window *d*, Plate 3. The force of the pump carried it to the fire end, nearly; the boiler being slightly inclined to the back end, the water slid back in one or more dark masses, moving down the central line, or diverted up the sides, greatly agitated and frequently changing its shape. The water generally disappeared at the back end, though parts were retained by accidental spots of sediment, and disappeared upon them. The table below gives the results of the second day's experiments on this subject; they were terminated by violently bursting out the glass window at the fire end of the boiler.

The height of the lower thermometer, as noted by an observer at the back end of the boiler, is given in the first column of the table, with the appearance of the bottom of the boiler, both being examined before injecting water. The gauge was allowed to fall to the height denoting one atmosphere, before giving the number of strokes of the pump, from which the quantities of water, in the third column, are taken. The pressures in the fourth column were noted on the gauge by the same experimenter, who threw in the water. The first effect was examined through the back window, *D*, Plate 3, and the temperature of the steam produced, before the gauge began to fall, was noted as is recorded in the fifth column. As in all the experiments, the steam was rapidly produced, and the total effect was the object sought, the time was no further noticed than to ascertain that accidental circumstances independent of the temperature, rendered the total time of evaporation very variable, and that the maximum of effect was always passed in the space of from one to four or five minutes.

Temperature of thermometer near bottom.	Appearance of bottom of boiler.	Water injected in fluid ounces.	Pressure produced by injection.	Temperature of Steam produced by injection.
			Atmospheres.	
306	Black.	2	3.3	336° F.
	Do.	Do.	3.4	340
330	Do.	Do.	3.3	356
	Red in part.	Do.	3.7	362
348	Red.	Do.	3.7	376
	Do.	3	4.2	
	Do.	5½	8.2	
384	Do.	5½	8.2	388
418	Do.	7½	8.7	424
428	Do.	10	9.8	448
448	Do.	Do.	12.0?	516

In the last experiment, the glass window at the fire end of the boiler, blew out with a quick sharp report, as loud as that of a musket; the fragments of glass, from a hole in the centre of the plate, were projected through a window, about three feet from the boiler, and could not be found. The number for twelve atmospheres is placed opposite to this experiment, as being an approximate result. In the act of observing the gauge, the glass burst, and the mercury at once fell: the number of inches at which the mercury had certainly risen, and above which it was, by an undetermined quantity, not, however, very considerable, was noted; and from this the pressure given in the table, is calculated. Here explosive steam was generated by the injection of water upon red hot iron, and in a time not exceeding one or two minutes at the most, the interval between the last stroke of the pump and the explosion, not having been sufficient to note the height of the gauge; the experimenter being at the pump, which was adjacent to the gauge.

By comparing the temperature of the steam in these experiments, with its observed pressure, it will be seen, that in not one of them was water enough injected to give the steam a density even approaching to that corresponding to its temperature: for example, 336°, F., should give a pressure of nearly 7½ atmospheres, instead of 3.3, the observed pressure; 388° should give more than 14\* atmospheres, instead of 8.2 and 448°; about 27½ atmospheres, instead of 10. The violence of the effect was not, therefore, carried as far as it might have been, the metal not having been cooled down as far as it might have been, to produce the greatest effect; and yet, within two minutes the pressure was changed from one to twelve atmospheres.

The rise of temperature shown in the first column, serves to prove, that by successive introductions of water, the metal was not so far deprived of heat as to be cooled towards the point of maximum vaporization, but that the results were obtained with metal heated to redness.

A similar experiment to these was made by our countryman, Perkins, but surcharged steam being present in the vessel into which heated water was

\* Arago and Dulong.

forced, it was to the action of this that he attributed his result. This opinion will be examined subsequently, but the attributed source of action was present only in a very attenuated state, if at all, at the beginning of each experiment made by the committee.

The repetition, and extension, of the experiments of Klaproth, was one of the most laborious of the undertakings of the committee, and the results will be found in a future article of the report.

*III. To ascertain whether intensely heated and unsaturated steam can, by the projection of water into it, produce highly elastic vapour.*

The supposition that water, thrown into hot and unsaturated steam, is flashed into highly elastic vapour, forms the basis of the theory of the explosion of steam-boilers, of our countryman, Perkins; a theory which has been embraced by many; and which, though shown to be contrary to the deductions from the well established laws of heat, is not now without its advocates. It seemed to the committee interesting to appeal to direct experiment upon this point, and thus to ascertain whether any circumstances, not embraced in the general view of the theory, existed; or whether all the circumstances had been rightly estimated, and the conclusions drawn from the application of the general laws of heat would be confirmed. Being unwilling to incur any considerable expenditure in this branch of their inquiry, the experiments were rendered uncomfortable beyond any thing which occurred in their other researches. The means of producing the unsaturated steam were these: a row of bricks was removed from the top of the furnace, and near to the boiler, thus laying bare nearly half the convex surface of the latter (five inches from the top). By building on the sides of the top of the furnace, with bricks, loosely arranged, a space was formed for placing fuel, having the boiler for its bottom, and bounded by the bricks on its sides. A cap of sheet iron above, served to promote the draught and to carry off much of the deleterious gas produced by the charcoal used as fuel. The fusible plate apparatus was removed from the boiler, to prevent injury, and the safety valve was surrounded by a tin to keep the fuel from contact with the valve. By filling the boiler about half full of water, and applying heat below, to raise the water to any required temperature, the upper half of the boiler would be filled with steam of an elasticity due to that temperature, this elasticity being measured by the gauge. Fire being now placed upon the top would heat the metal of the upper half of the boiler; and this, by communicating its heat to the steam, would surcharge the latter. To measure the temperature, thus acquired by the steam, as well as that of the water below it, thermometers were placed in the iron tubes already described; the mercury was removed from the tubes, except enough to cover the bulbs of the thermometers, so that the temperature shown by them might be, as nearly as possible, that of the steam by which the shorter tube was surrounded, and of the water, into which the longer tube dipped. The scales of these instruments were protected from the fire, by surrounding them, at some distance, by tin plates. The scales were of seasoned box wood, the refinement of a correction for the errors of the instruments was not considered to be at all required by the nature of the research, the results of which errors, even a few degrees of temperature would not materially affect. In the final experiments, on this subject, the thermometers, with metallic scales, and surrounded by water, were put in place. The apparatus for injecting water, consisted of a tube attached to the stop-cock, *v*, Plate 1, on the back head of the boiler, and which communicated with the forcing pump; the tube terminated in a spherical segment, in which fourteen holes, each of the size of a cambric needle, were made; through these the water was forced in spray. By examination it appeared that the small stream, from the highest hole, struck the top of the boiler near the safety valve; that two or three struck the front head;

two or three the water in the boiler, near the back head, leaving from seven to nine apertures, the water from which crossed the steam chamber in an inclined and very effective direction. The effect of the streams from the three or four apertures, first spoken of, would be, if they were not taken up by the steam, to vitiate, in degree, the experiments, by striking the top and end of the boiler. With the openings, thus described, the first day's experiments on this subject were made. The heat of the surcharged steam could not, with the arrangements then provided, be raised above 484 degrees. The method of experimenting, having been the same as was subsequently used, may as well be stated in this place. The fire having been applied below the boiler, the water was heated to a temperature corresponding to from one and a half to two and a half atmospheres; the coals were then, in part, removed to the top of the boiler, fresh fuel being supplied below: the effect of the heat applied above was soon visible upon the thermometer in the steam, and upon the gauge. When the temperature of the surcharged steam sufficiently surpassed that of the water, as shown by the larger thermometer, the injection of water was commenced, the injection pipe being carefully kept cool by wet sponges and cloths. The temperature of the thermometers in the water and steam, were noticed both before and after the injection, by one experimenter, while a second made the requisite number of strokes of the forcing pump, observed the indications of the steam gauge, and when the experiment was concluded, gave the quantity of water used. The temperature of the air in the gauge was noted from time to time. The apertures in both the heads were secured with metallic plates, to prevent leakage through them.

On the second day, six of the fourteen small holes were plugged up, that the source of error, already mentioned, might not exist. The temperature attained by the surcharged steam was  $440^{\circ}$ , at, and below which, experiments were made. The general nature of the results, obtained on the first and second days, coincide, allowing for the difference of circumstances, so entirely with those of the final trial, when a satisfactory temperature was obtained in the surcharged steam, that it would be uninteresting to detail them. The same remark may be made of subsequent trials.

As the quantity of water thrown in, during all these experiments, was small, it was considered advisable to increase it, in order that more marked effects might be obtained; this was done by removing the pierced head from the pipe, thus delivering nearly the full capacity of the pump at each stroke. The quantity of water thus injected through the steam by each stroke of the pump, was, at a mean, half a fluid ounce. No heating of the injection water was required, as the heat necessary to raise water from the temperature of the experiments to the boiling point was but a small fraction of that required to convert it into steam.

In the last day of trial the heat of the top of the boiler was so great and so long sustained, that the thermometer in the water became, in the course of the experiments, for reasons which will be stated, comparatively useless, as an indicator of the temperature of the water. The following tabular view of the results of the experiments is extracted from the minutes. The first column of the table contains the temperature of the surcharged steam, previous to the injection of water in any experiment, the second column that after the injection, this comparison being made to ascertain whether the heat supplied was, or was not, sufficient to make up for that consumed in vaporizing the water thrown in. The third column shows the quantity of water injected; the fourth the height of the gauge before the experiment; the fifth the height after the experiment; the sixth the temperature of the gauge; the seventh and eighth, the pressures in atmospheres, calculated from the height of the gauge, and the temperature of the air within it, before and after each experi-

ment. No notice is taken of the temperature of the scales of the thermometers, it having varied but  $10^{\circ}$  Fah. namely, from  $86$  to  $96^{\circ}$ .

The first experiment is introduced, to show the temperature of the water within the boiler, before the long continued heat had sensibly affected the indications of the thermometer.

Height of Thermometer in Steam.		Ounces of water injected.	Height of Gauge in inches.		Temperature of air.	Height of Gauge in Atmospheres.		REMARKS.
Before exp't.	After exp't.		Before exp't.	After exp't.		Before exp't.	After exp't.	
376		0	21.17		65	5.72		For comparison, no water injected. Water in the boiler, $318^{\circ}$ Fah.
462	463	2	21.30	21.25	66	5.85	5.80	
506	509	3	21.50	21.50		6.15	6.15	Gauge stationary.
508	510	7	21.52	21.47		6.21	6.07	
518		0	21.80		70	6.65		Temperature of air in gauge noted between two experiments. Gauge fell slightly, then rose to original level.
519	521	3	21.80			6.65		
522	524	6½	21.80	21.70		6.65	6.48	
526		10	21.80	21.65		6.65	6.41	
528	528	13	21.80	21.60		6.65	6.34	
532		0	21.90			6.82		
533	533	6	21.90	21.85		6.82	6.74	Rose again immediately to 21.90.
533	533	14	21.90	21.70		6.82	6.48	Fell nearly .2 inch. <i>Note.</i> $533^{\circ}$ is, according to the formula of Arago and Dulong, the temp. of saturated steam of more than <i>sixty atmos.</i>

At the close of these experiments, the metal was, in many places, but little short of a red heat, visible in daylight.

The precise state of things in a boiler, of which parts are unduly heated, was represented in these experiments; there was the surcharged steam, and heated metal ready to give up its heat to replace what might be absorbed in the conversion of the water injected, into steam. This latter circumstance renders the case different from that contemplated in the deductions of theory which have been brought to bear upon the question. The greater or less intensity of the heat afforded by the top and sides of the boiler would necessarily modify the effects observed, by the injection of any given quantity of water; this is observable in the numbers given in the table, where although the greater quantity of water injected does not fail in two consecutive experiments to show a greater depression of the gauge, yet in distant experiments the same is not the case. *We see that in no case was an increase of elasticity produced by injecting water into hot and unsaturated steam, but the reverse, and in general that the greater the quantity of water thus introduced, the more considerable was the diminution in the elasticity of the steam.* The quantity of water injected was from 3.5 to 24.3 cubic inches. The immediate rise of the gauge after each experiment, shows how rapidly heat was supplied by the sides of the boiler to the steam within.

That the steam was highly surcharged with heat, appears by comparing the pressures corresponding to the temperatures, with those given by Dulong

and Arago, for saturated steam. For example, the pressure shown by the gauge when the steam was at  $506^{\circ}$  Fah. was 6.15 atmospheres, while the table just referred to gives for this temperature a pressure of *forty-eight atmospheres*. The temperature was carried to  $533^{\circ}$  Fah. when the pressure shown by the gauge was 6.82 atmospheres, while saturated steam at that temperature would have had a pressure of more than *sixty atmospheres*.

In order to ascertain whether the thermometer relied upon to give the temperature of the steam was affected, if at all, in excess or defect by the conducting power of the metal; the temperature of the boiler just beyond the tubes was taken, as nearly as was practicable, by a thermometer, R, Plate 1, dipping into a clay receptacle, upon the top of the boiler. This thermometer did not rise above  $405^{\circ}$  Fah.; its distance from this source of heat was ten inches, and that of the iron tube inclosing the thermometer, six and a half inches. Supposing the temperature stationary on top, the temperature of the metal of the top of the boiler near the tube of the thermometer would have been  $479^{\circ}$ ,\* showing that it tended to carry off heat from the thermometer, which, if at all affected by the metal above it, showed too low a temperature for the steam in contact with it. The temperature of the source of heat would have been from these data,  $582^{\circ}$  at the extreme end of the part covered with fuel, which was of course at a lower temperature than the middle portion.

On examining the apparatus after the conclusion of the last day's experiments, it was found that some of the putty used in tightening the lower joint of the thermometer in the water, had been softened by the heat, and had flowed into the tube, thus affording a direct communication between the steam and the bulb of this thermometer: this circumstance accounts for the instrument being affected in this day's experiments and not in the preceding ones.

\* If we suppose the heat of a small bar of metal, cut from the top of the boiler, to have been derived by the conducting power of the metal alone, the heating effect of the steam within being neglected, and further, that the temperatures of the bar had become constant, then the ratio of the excess of the temperature ( $y$ ) of any point at a distance ( $x$ ) above the temperature of the air, to that ( $y'$ ) of any point at a distance, ( $x'$ ) is given by the proportion,

$$y' : y :: \text{Log. } x : \text{Log. } x'.$$

In the case before us,  $y = 405 - 80 = 325^{\circ}$ ,  $x = 10.0$  inches, and  $x' = 6.5$  inches, whence  $y' = 399^{\circ}$ , and the temperature at that point is  $y' + 80 = 479^{\circ}$ .

To find the temperature of the source of heat, we have the equations—

$$y' = A e^{-x' \sqrt{\frac{2h}{kl}}} \quad \text{and} \quad y = A e^{-x \sqrt{\frac{2h}{kl}}}$$

in which  $y'$  and  $y$  are the excesses of the temperatures at the distances  $x'$  and  $x$  over that of the air.  $A$  is the temperature of the source,  $e$  the base of the Naperian logarithms,  $2l$  the thickness of the bar, and  $\frac{h}{k}$  the ratio of its radiating to its conducting power.

To find  $\sqrt{\frac{2h}{kl}}$ , which is the same for the two points  $x$  and  $x'$ ; we have

$$\frac{y'}{e^{-x' \sqrt{\frac{2h}{kl}}}} = \frac{y}{e^{-x \sqrt{\frac{2h}{kl}}}}, \quad \text{whence} \quad \text{Nap. log. } y' + x' \sqrt{\frac{2h}{kl}} = \text{Nap. log. } y$$

$$+ x \sqrt{\frac{2h}{kl}}, \quad \text{and} \quad \sqrt{\frac{2h}{kl}} = \frac{\text{Nap. log. } y' - \text{Nap. log. } y}{x - x'}$$

in the case before us,  $\sqrt{\frac{2h}{kl}} = .058$  and  $\log. A = \log. y' + x' \sqrt{\frac{2h}{kl}} \cdot \log. e = 2.765$ ,

and therefore  $A = 582^{\circ}$ .

The boiler must have been hotter at the furthest point than it would have been if not in contact with the surcharged steam.

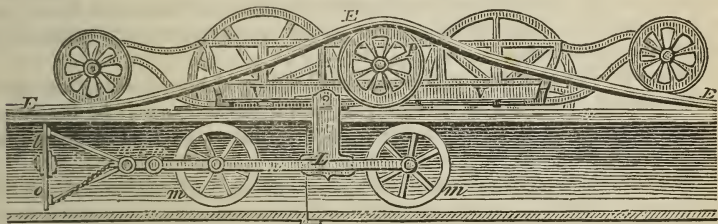
(To be continued.)

## Pneumatic Railway.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A very warm controversy has been carried on in the pages of the London Mechanics' Magazine, in relation to the pneumatic railway recently patented by our countryman, Mr. Pinkus, now a resident of London. To give the readers of this journal an idea of the nature of this patent, a cut is subjoined, representing a section of the tunnel forming the railway, and showing the carriage to be propelled in its connexion with the tunnel.

The method of propulsion is by rarifying the air in the conduit pipe in front of the shield *o*, which is supposed to move air tight. The pressure of the air behind the shield will then urge it forward. This shield, or as Mr. Pinkus terms it, "dynamic traveller," is connected with guide wheels *mm*, which keep the bar *S L* in the axis of the tube. To this bar is connected an upright arm, *p*, passing through a slit in the upper side of the pipe or tunnel, and intended to transmit the motion of the shield, *l o*, to the car, *V V*. The slit thus required in the upper side of the tunnel is closed by a



"square cord," shown in the figure, *E E E*, passing over one and under two wheels; the middle wheel lifting the rope as the carriage, *V V*, proceeds, and the front wheel guiding it to its place upon a groove made to receive it, and thus closing the slit. The car, *V V*, or "governor," as it is termed in the specification of the patent, moves upon two rails, attached one to each side of the tunnel, and parallel to its axis.

Mr. Pinkus claims, as new, these various arrangements, with minor ones not described, and disclaims, as old, the use of the tunnel as a means of transport for goods, &c. in its interior.

The prospectus of "a National Pneumatic Railway Association" was accompanied by the opinions of Dr. Lardner and Prof. Faraday in regard to this means of locomotion. The opinion of the former gentleman was decidedly favourable. The practicability of the scheme he does not doubt. Considers it a frictionless mode of transferring power to a distance. Calculates the necessary rarification to be produced in the tube or tunnel, and the power obtained. The relative economy of this new, and of the *old* rail way. The diminution of accidents to cars, and upon inclined planes. Examines the difficulties of keeping the tunnel air tight, and concludes that they are not insurmountable.

Mr. Faraday modestly remarks, that he possesses no *practical* experience in regard to railways, but approves, in general, of the principles of the pneumatic railway, and enumerates some advantages which will accrue from its substitution for those of the ordinary kind.

The editor of the Mechanics' Magazine, notwithstanding the weight of authority thus against him, contends, that both in theory and practice, this

project is to be condemned, and quotes the experiments of Papin and others to show that air is not to be passed through tubes without friction. He refers, also, to the unsuccessful attempts of Valance to press air through a tunnel. These and other experiments to the same purport, the reader will find in vol. ix. of this Journal. A committee of the Institute reported upon a plan identical in *principle* with that of Mr. Pinkus, and the table drawn from the best experiments on the resistance of air to motion through tubes, shows how much power would be consumed in producing a given effect in a tunnel of a given length.

Here the view is taken, that the operation of drawing the air *out* of a tube, is of the same nature with that of forcing it in.

But on the contrary, Mr. Pinkus, in a reply to the editor of the *Mechanics' Magazine*, states that Mr. Hague has succeeded in applying the principle of Papin to communicate power to the distance of even seven miles, and that in one of his works, the power of a seventy horse steam engine is transmitted undiminished, and instantaneously, through a tube three miles in length. He further states, that the gas for lighting Birmingham is brought seven miles through pipes, with but a small diminution of force. Of the apparatus of Mr. Hague we have heard for the first time, but must remark that the latter fact is in contradiction to all the experiments hitherto made on the passage of gas.

The readers of this Journal would probably not be interested in the personalities of the articles in relation to this subject, and they have before them the means of forming a correct conclusion as to the merits of the pneumatic railway.

As one of the readers, I cannot approve of the scheme either in theory or practice. Not in theory, because of the consumption of power required to rarify the air in a long tube. Not in practice, from the primary difficulty of the long, uniform cylinders or tunnels required for the motion of the piston; and the secondary one, of the improbability of an air tight joint resulting from the "square cord" and groove.

B.

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*Query in relation to the appropriate colour for the covering of the pipes of Condensers used in the manufacture of Gas.*

TO THE COMMITTEE ON PUBLICATIONS.

*Gentlemen*,—Allow me to request from any one of your correspondents a reason why the pipes used for condensers at the Philadelphia Gas Works, are painted white. I understand their object to be to expose the gas as it comes from the retorts to the cooling action of the air. If so, the metal should be covered with some dark coloured paint, which, radiating better than the white, will keep the metal cool, and thus more effectually cool the gas. I take it for granted that the iron of the pipes forming the condenser must be coated to keep it from the effects of the weather, and if I am *right* in regard to the philosophy of the matter, the engineer is *wrong*.

Yours, &c.

K.

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*Substitute for a Waste Cock to Hydrants.* By ROBERT CORNELIUS.

It is well known, that to prevent the freezing of water contained in the pipes of our hydrants, a waste cock has been applied to the lower part of the pipe through which water is drawn. This cock is opened by the same

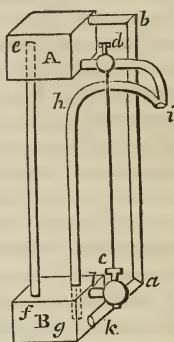
operation which closes the escape pipe. The water from the escape pipe issues out, therefore, and passes into the ground.

Newton's patent hydrant conveys the waste water to a box, and remedies the inconvenience occurring from the process just alluded to.

The invention of Mr. Cornelius is to effect the same object. His arrangements, as explained at the last conversation meeting of the Institute, will be understood by referring to the annexed diagram. The parts are not there disposed as they will be in practice; the apparatus would want compactness in this form: they are displayed for the sake of explanation.

The box, A, is connected with the top of the hydrant, and B is placed below the ground so far as to prevent the water in it from freezing. The pipe, *a b*, is connected, near *a*, with the branch pipe, *k*, from the main water pipes, and at *b*, with the upper part of the box, A. The stop cock, *c*, opens or closes at pleasure the end, *a*, of the pipe, *a b*. This cock has two passages, one opening from *k* to *a b*, the other, through *l* to B. When one of these is open the other is closed, and vice versa. It is connected by the rod, *c d*, with the cock, *d*. When water is to be drawn, these cocks are brought into the position shown in the figure, when *c* is open and *d* closed; the water flows through *c*, and rises into the tube, *a b*, filling the box, A. The stop cock, *d*, being closed, the air from A passes by the tube, *e f*, into B, and escapes through *g h* at *i*. When the water has risen above the mouth, *e*, of the tube, *e f*, *e* being near the top of the box, A, it flows through *e f* into B. At first the compressed air in B finds a vent through *g h*, but soon the water rising above *g*, seals the pipe, *g h*, and the air is compressed in the upper part of B, until the elastic force is equal to that which the head of water can produce. The water in B meanwhile rises in *g h*, and at length escapes at *i*. When the hydrant is to be stopped, the cock, *d*, is turned. The same turn which opens *d*, closes the passage from *k* through *c* to *a b*, and opens that between *a b* and B. The cock, *d*, being open, the water from the box, A, flows out at *i*. The air in B passes through the pipes, *a b* and *e f*, into A, and the water which is in *g h*, and with any which may not be carried by the air through *a b*, descends into the box, B. The dimensions of the boxes, A and B, being duly regulated, and the pipes, *h g* and *e f*, properly placed, this hydrant will be very efficacious.

The quantity of water contained in the upper box, A, must flow from the hydrant after the stop cock, *d*, has been turned.



## Civil Engineering.

*Report, to the President and Directors of the Sandy and Beaver Canal Co.,  
By E. H. GILL, Civil Engineer, and Chief Engineer of the Sandy and  
Beaver Canal.*

GENTLEMEN,—In compliance with your request, I have the honour to lay before you the following report of the present state of the work under my direction:—

During the past summer the whole line has been minutely traced, with a view to a permanent location: by this survey the total extent of canal has

been reduced three miles, or the distance from the Ohio river at the mouth of Little Beaver creek to the western termination at the Ohio canal, by the recent examination and location will not exceed seventy three and a half miles.

The Eastern division of the canal, extending from the Ohio river to a point two miles west of New Lisbon, embraces a distance of about twenty-seven miles, of which seventeen miles are "slackwater;" for this description of improvement the stream is exceedingly well adapted, the valley being narrow and the banks bold and prominent, affording numerous and eligible sites for the locks and dams, and an abundance of good materials for their formation.

The summit or middle division is about fourteen and a half miles in extent, and the Western division, terminating at the Ohio canal, about thirty-two miles. The latter division extends through a country affording the greatest facilities for constructing a cheap and permanent improvement; the valley of the creek is broad and has nearly a uniform declivity from its source to its confluence with the Tuscarawas. On the Eastern division the lockage is four hundred and sixty-four feet, and on the Western two hundred and five, constituting in all six hundred and sixty-nine feet. In locating the Western division, the level has been kept up from Williams' mill dam to the debouch into the Ohio canal at the flourishing town of Bolivar, by which arrangement an excellent water power is secured to the Company, affording a head and fall of twenty-six feet: the owners of the property at the site selected for using the water have liberally ceded to the Company ten acres of very valuable land for that purpose. Sandy Creek at that point will yield a sufficiency of water, independent of the requisite supply for the canal, *at all times to work* twenty, and for eight months in the year *fifty pairs of mill stones*. This power may reasonably be estimated as worth \$6000 per annum. Many other valuable sites for hydraulic purposes have been created or purchased along the route, which, in conjunction with the one above mentioned, will probably afford the Company a revenue of \$7000 per year.

On the Eastern division of the line, forty-nine sections, or twenty-four and a half miles of canal, thirteen dams, and forty-six locks, are now under contract: on the Middle division, twenty-one sections or eleven miles, including the tunnels and the reservoir mounds on the west fork of Little Beaver Creek and Cold Run: and on the Western division twenty-eight sections or fourteen miles, eleven locks, one dam, and the aqueduct over the Tuscarawas river, constituting in all forty-nine and a half miles of canal, fourteen dams, fifty-seven locks, one aqueduct, and two reservoir mounds now under contract.

The work has been prosecuted in most cases with energy, and is now in a greater state of forwardness than could reasonably have been anticipated, considering that the season was far advanced when it was commenced. About thirty-four sections or seventeen miles of canal are now completed, and likewise the mason work of two locks, and 144,000 cubic yards of excavation removed from the summit deep cuts: dam No. 2, on the Western division, will probably be completed next week.

The foundations of five other locks and two dams are laid, and 1500 perches of wall built; and a large quantity of stones and other materials for the construction of locks and dams is prepared and on the ground; and I have no doubt all the work now under contract, excepting the tunnels and aqueduct, will be finished in the approaching year.

The work placed under contract is in most instances in the hands of responsible and efficient men, and has been taken on terms exceedingly favourable to the Company. There is at the present period on the line a force equivalent to 2160 men. The cost of the locks, which are built in the most durable manner of cut sandstone, will not exceed \$700 per foot lift, being about thirty per cent. below the ordinary cost elsewhere. The cost of the dams, which are in most instances fourteen feet high, will average about twenty-eight dollars per linear foot across the stream; and the canal, exclusive of locks and dams, generally from \$3000 to \$5000 per mile.

A contract has been entered into for furnishing the remainder of the hydraulic cement; it is found in abundance contiguous to the line; the quality is equal to any I have seen, and the cost extremely moderate.

The contract for excavating the tunnel and approaches, has been taken by energetic and persevering contractors on reasonable terms, the former not exceeding the estimated cost: this work is to be completed by May 1837. As much has been stated in relation to the adequacy of the supply of water on the summit, it may be proper to remark, that during the past season I commenced and have continued a series of minute examinations of the most prominent streams relied on for a supply: those examinations have thus far fully corroborated the truth of the statements and calculations embraced in the report made to you last autumn by Mr. Hage and myself. I feel fully satisfied, that with the aid of the reservoirs that can be constructed on the summit, at a moderate cost compared with their utility, a much larger quantity of water may be introduced into the summit and its dependent levels, than will be requisite for the transit of the immense trade that is destined to seek a market through its channel. The reservoirs now under contract will contain as follows: West Fork reservoir, 130,000,000 of cubic feet; area 350 acres: Cold Run reservoir, 88,000,000 of cubic feet; area, 250 acres: in addition to which it is proposed to elevate the banks of the canal so as to retain one foot in depth of available water, and flood several pieces of low ground on its northern or upper side, amounting in all to about 150 acres, which, when full, will furnish about 6,500,000 of cubic feet, making in the aggregate from these sources alone, an available supply of 224,500,000 cubic feet of water, a demand on which *may* be requisite in a dry season for a period of 100 days. By calculation it will be perceived, that these reservoirs will afford for that period 2,245,000 cubic feet of water per day, equivalent to a discharge of 1559 cubic feet per minute. If to this sum is added the minimum natural flow of water on the summit as reported to you last autumn, (558 cubic feet per minute) it will be observed that the flow of available water in a dry period will amount to 2117 cubic feet per minute, or sufficient, after deducting all that the nature of the soil and climate will require for leakage, filtration and evaporation, for the passage of 185 *boats per day*. The West Fork and Cold Run reservoirs are about one mile apart: when filled, the surface of the water in each will occupy the same plane, or be elevated to the same height: it is designed to have a feeder extending from one to the other, so that the surplus water in one can be admitted into the other, if required. A large waste weir is to be constructed on this feeder for the purpose of discharging the waste water when both reservoirs are full. This water, when thus discharged, is conducted into the reservoir on the summit level. The first two mentioned reservoirs will receive the drainage of twenty-four square miles of country; the summit, *the drainage of eighty square miles*. The usual depth of rain that falls in this section of country can, I am informed,

with safety be premised at thirty-six inches per annum, or equal to a column of that height, being 83,635,000 cubic feet on a square mile, and on twenty-four square miles 2,107,244,800 cubic feet annually. From experiments made on a large scale elsewhere, for practical purposes, it has been ascertained conclusively, that seventy-five per cent. of the rain that falls can be laid up in reservoirs. From this data it will be observed, that the three reservoirs above alluded to may be filled seven times per year. This exhibit will probably satisfy the most sceptical as to the adequacy of the supply of water. As to the immensity of the trade that will wend its way through the Sandy and Beaver canal to an Eastern market, I believe there has never been surmised a doubt: a glance at the map will prove conclusively that a very large portion of the produce of Michigan, Illinois, Indiana, Kentucky and Ohio, which are rapidly increasing in population and wealth, must be wafted through it. The business of that section of country is now to a great extent accommodated by the New York improvements, but the completion of the Sandy and Beaver canal will secure to it a safer transit to and from the seaboard, much shorter, and *navigable six weeks earlier in the spring and three later in the fall* than the one now traversed; being sufficient inducements to secure it. What the extent of that trade will be, time alone can develop. On the Erie and Champlain canals, a very large portion of the business done on the first of which is derived from the country above mentioned, there have been received in tolls in 1829 \$759,055, 1830 \$1,032,476, 1831 \$1,194,610, 1832 \$1,196,008, 1833 \$1,324,521, 1834 \$1,292,956, and there is no doubt that the business of this year will greatly exceed the last. On the Ohio canal there was collected in 1832 \$82,867, 1833 \$136,920, 1834, \$151,287, and the amount of tolls received the present year at some of the collectors' offices exhibits an increase of forty-five per cent. over the last.

When the canal or rail-road authorized by an act of the legislature of this State at their last session, to be constructed from the western termination of the Sandy and Beaver canal to the Miami canal, near the mouth of the Auglaise river, shall have been completed, it must add an immense revenue to your work, as it, in connection with the Wabash and Erie canal through Indiana, and the contemplated rail-road through Illinois to the Mississippi river, will constitute a continuous chain of internal improvement, extending westerly from the Sandy and Beaver canal 500 miles, and from Philadelphia 1000, into the rich and fertile regions of the west.

The following synopsis of the distance the trade of the country situated west and south-west of the Sandy and Beaver canal would have to travel from the western termination of that work, in order to reach a market by the various routes now or about to be, afforded it, will fully justify the conclusion that it must seek a passage through it.

*Distance by the Ohio Canal, Lake Erie, New York Canal and Hudson River to New York.*

From the Sandy and Beaver canal to Cleveland	80 miles.
From Cleveland to Buffalo . . .	200 "
From Buffalo to New York . . .	515 "
	<hr/>
Total	795 "

*Distance by the Ohio and Mahoning Canals and Pennsylvania Rail Road to Philadelphia.*

From Bolivar to Akron	.	.	.	42 miles.
From Akron to Beavertown	.	.	.	114 "
From Beavertown to Pittsburg	.	.	.	28 "
From Pittsburg to Philadelphia	.	.	.	394 "

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Total 578 miles.

*Distance by the Sandy and Beaver Canal and Pennsylvania Improvements to Philadelphia.*

From Bolivar to Beavertown	.	.	.	87½ miles.
From Beavertown to Pittsburg	.	.	.	28 "
From Pittsburg to Philadelphia	.	.	.	394 "

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Total 509½ miles.

From the rapid increase in business on the New York and Ohio canals, it is to be presumed that when the Sandy and Beaver canal shall have been finished, the tolls on the Ohio canal will amount at least to \$400,000 per annum; and from the foregoing facts and statements it is to be inferred, that two-thirds of that trade will pass through the Sandy and Beaver canal, which would nett the holders of stock in that work, at the rate charged on the Ohio canal, an income of at least \$60,000 the first season.\* If to this sum is added the amount that may be anticipated from the liberal grant contained in the amended charter,† which cannot fall short of \$150,000, the Company will receive, in the first year after the work is finished, \$210,000 in tolls—independent of the large business that may be expected from the country west and north-west of the termination of their work—presenting the novel result of a canal yielding seventeen per cent. on its entire cost the first year after its completion.

All of which is respectfully submitted.

E. H. GILI, CHIEF ENGINEER *S. and B. Canal Co.*

NEW LISBON, Ohio, Nov. 11, 1835.

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## Physical Science.

*Of the Tidal Motions of Conductors, free to move.* By JNO. W. DRAPER, Christiansville, Mecklenburg, Va.

1. “† Dans d'autres circonstances on observe encore au milieu des masses liquides, des mouvemens singuliers qu'il est excessivement difficile

\* The estimate may seem large, but it must be kept in mind that the Sandy and Beaver canal will constitute a connecting link between two large and important works, (the Ohio and Pennsylvania canal improvements) now completed; consequently it has not, like other canals, to await the growth of business.

† The amended charter secures to the Sandy and Beaver Canal Co. all the tolls collected on the Ohio canal from boats that have passed through the Sandy and Beaver canal for seven years after its completion.

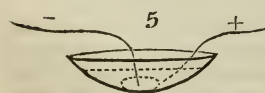
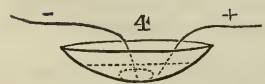
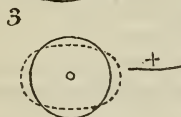
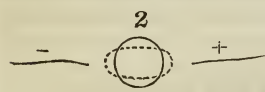
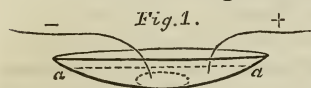
‡ In other cases there occur in liquids, singular motions which are so numerous and changeable as to be very difficult to describe. I shall attempt to give some notion of them, remarking, however, that notwithstanding the many experiments which I have made on the subject, I have not been able to determine any general law respecting them.

de décrire, tant ils sort nombreux et changeans. Je vais essayer d'en donner une idée, en remarquant toutefois, qu'après avoir fait de nombreuses expériences sur ce sujet, il m'a été impossible d'en saisir la loi."—(POUILLET.)

2. The singular movements here spoken of by Pouillet, have likewise drawn the attention of several other philosophers. Erman and Serullas have both recorded instances of gyratory motion, produced in certain bodies, especially mercury, by the contact of others. There is also a similar observation, made by some of the earlier chemists, respecting camphor. Strange motions of an analogous description, are also observed in some liquids, under the influence of a voltaic current; these, in the case of mercury, have been particularly studied by Sir J. Herschel, who obtained several remarkable notices respecting them; they are, however, so far as I am informed, as yet without explanation.

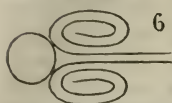
3. If into a watch-glass, or shallow capsule, as *a, a*, fifty or sixty grains of mercury is poured, and over that as much water acidulated with sulphuric acid, as is sufficient to cover the surface of the mercury, and the positive and negative wires of a battery of twenty or thirty plates, arranged as indicated in figure 1, the mercury being in contact with the negative pole, and the positive pole being plunged into the water, at a short distance from it, currents are produced, both in the water and in the mercury. Supposing the power of the battery sufficient, the same effect takes place on removing the negative wire out of the mercury, into the water; but if the positive wire is in contact with the mercury, and the negative with the water, there is no motion at all, or at most, the mercury only curls itself up, into an elongated figure.

4. This motion varies according to several circumstances, but chiefly the position of the two wires. 1st. If the wires be as in figure 2, or on opposite sides of the mercury, the metal instantaneously elongates as shown by the dots, and currents also are seen playing in the water. 2nd. If the negative wire be introduced into the centre of the metallic globule, and the positive wire be brought on one side, as in figure 3, the mercury will bulge out *elliptically*, at both sides, nearest and furthest from the positive pole—and by regulating the force of the battery, either by changing the number of the plates, or altering the strength of the solution acting on them, the experiment may be so managed, that no motion shall ensue in the mercury, after this elliptical bulging is effected; but now, if the negative wire is cautiously raised from its position, so as to be just out of contact with the surface of the metal, as in figure 4, the mercury is immediately convulsed, and its whole surface covered with a kind of circular waves. On lowering the negative wire to its former position, and advancing the positive, as in figure 5, the moment it comes to the edge of the mercurial ellipsoid, the most intense convulsions are produced, which increase



until contact of the mercury and wire is obtained. 3rd. If the two wires form a kind of triangle with the globule, it turns upon itself.

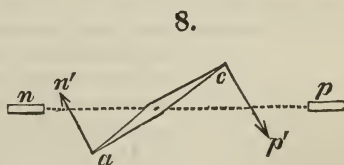
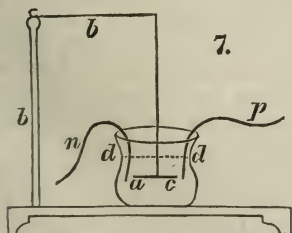
5. At the same time that these movements are going on in the mercury, the surface of the water is ploughed by gentle currents, exactly resembling those produced by a breath from a blowpipe, directed slantingly across the surface, as in figure 6.



6. In proceeding to give an explanation of these motions, I shall not follow the analytical course of experiment, used in my researches, but commence with those principles, on which a true explanation is founded.

7. It has long been known, that the elements of compound substances, were held together in virtue of an affinity among themselves. Sir H. Davy, Berzelius, and other chemists, were led to suspect that this was due to the electric condition of those elements, and pursuing this hypothesis in its details, several brilliant discoveries were made, which ultimately changed the face of the science. Apart, however, from all hypothetical reasoning, it was found, that the poles of a voltaic battery had the power of influencing the atomic constitution of bodies, so as to be able to hold all chemical combination under control. This remarkable effect was imputed to the electrical attraction and repulsion of the battery—but a battery which is competent to the rapid decomposition of water, and even the reduction of potash, is found to give exceedingly faint traces of any electro-dynamic effect, being unable to cause the divergence of a delicate gold leaf electrometer, or affect the indications of a torsion balance. In the course of certain experiments, I had occasion to notice, that this effect, as to intensity, is entirely regulated by the medium in which the experiment is made; as for instance, a thin lamina of air, or gaseous matter, is nearly a perfect non-conductor to electricity of low intensity, but an expansion of water offers no such resistance. I hoped, therefore, that though I might not be able to exhibit the attraction of a polar wire for a suspended needle in the Coulomb balance, such an effect might ensue, if the experiment was made with the apparatus plunged in another atmosphere, whose conducting power differed from that in which we live. For the conducting power of a medium has no relation either to its cohesion or its chemical properties, and it did not appear improbable, that one might be found, which, though it should not interfere with the freedom of motion of a wire plunged in it, its conducting power, in relation to electricities of very low intensity, might exhibit those effects in a more elevated point of view.

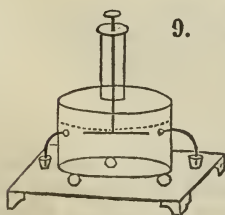
8. To illustrate this reasoning, I took a platina wire, *a, c*, figure 7, two inches in length, and suspended it by a raw silk thread from a stand *b, b*,



into a vessel filled with acidulated water, as high as *d, d*. The needle was so arranged, that when it hung with freedom, it was about one-fourth of an inch distant from the extremities of two platina pointed wires, *p, n*, which

entered the vessel on opposite sides, and could be made to communicate at will, with the opposite poles of a battery. Now the wire  $p$ , being positive, and  $n$  negative, the extremity  $a$  of the suspended needle would be negative, and the extremity  $c$  positive, by induction. The conjoined effort of the forces thus brought to bear on the needle, acting on its opposite extremities, in opposite directions, would solicit it to move on its axis, the extremity  $a$  in the direction  $n'$  figure 8, and the extremity  $c$  in the direction  $p'$ , the line of rest would be as expressed by the dots in the figure, and slow oscillations should take place on either side of that line, if the density, or other properties of the medium permitted.

9. The experiment was thus tried, and to prevent any derangement from hygrometric twist of the silk, the needle was hung on a glass thread, of sufficient length to reach above the surface of the water, and there attached to the silk; on passing the current of forty-five pairs of four inch plates, the needle immediately moved, and after two or three oscillations, took its position of rest; on being moved to the opposite side of the polar wire, an opposite motion ensued, until the same position was gained. During this movement, gas was freely liberated from the extremities of the polar wires, and also from both ends of the needle, which hindered considerably that freedom of motion, which I had hoped for in observing the oscillations. The experiment was also varied, by terminating the polar wires with plates of platina, with a view of increasing the effect; the needle was also suspended in pyroligneous ether, and the attractive power of the same battery, newly charged, was very marked; it was not so observable in alcohol, and still less in muriatic acid; in ammonia, though only one end of the needle appeared to evolve gas, it was not so obedient to the attractive force. These circumstances indicate that the phenomena of motion, as here exhibited, have not their origin in any magnetic action produced either by the disturbance of the earth or the passage of the voltaic currents. Magnetic action to be complete, requires that the bodies, along which currents are passing, should be possessed of high conducting power, hence a thermal current whose tension is almost extinct, is still capable of producing a powerful effect on a suspended needle. A current capable of producing a given deviation when moving along metallic wires would meet with resistance in passing through water, and alcohol, or ether would forbid its passage. It is moreover impossible to produce any visible effect on the platina wire of this arrangement by the action of a solitary pair, even possessing extensive surface, though the same pair if cut into lesser plates, and arranged for the production of a current of greater tension, immediately causes the movement here described. Dr. Faraday has stated, in his recent researches on this point, that there is not any proof that the poles of a battery do exercise any power of attraction or repulsion, (Bache's, Turner's Chem. page 102, idem 108,) but that opinion would appear to be inconsistent with the fact—there must be an



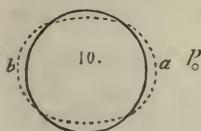
accumulation of tension on an electrode, if the medium which separates it from its fellow, is not so good a conductor as the liquid filling the cells of the battery; and experiment warrants this conclusion.

10. The principles here laid down, also indicate the construction of a GALVANOMETER, figure 9, which I have recently fitted up. It is intended to exhibit by the torsion of a fine fibre, the force of attraction between the polar wires, and the ends of the suspended needle. The only obstacle I have as yet observed to the accu-

racy of the result furnished by it, is due to the development of gas on the polar wires, and on the needle.

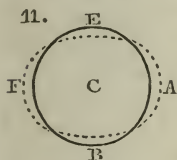
11. The doctrine which I wish to establish from this experiment, is, that though the polar wires are plunged in a conducting medium, and the current is actually passing, yet they still act as centres of attraction. The motions of mercury and other fluids are only exemplifications of this doctrine.

12. When a spheroidal mass of conducting matter, is brought in presence of a point of attraction, situated at a distance from its surface, the particles on that surface will be differently affected, as their situation in regard to the attracting point varies. Thus on touching the mercurial globule, named in the first part of this paper, with a negative wire, and introducing into the water a positive platina pole, the globule, which before was spherical, becomes elliptical, as represented in figure 10, two tides are formed upon it, as at *a* and *b*, one directly opposite the positive wire *p*, and the other 180 degrees from it, meanwhile there is an ebb in those regions which are situate a quadrant from the point of attraction. If the positive wire is made to revolve



round the globule, both tides move, always keeping the same relative position to the point of attraction, that they had at first. It only requires the force of the battery to be appropriately moderated, to exhibit these phenomena with the utmost rigidity. And, as these motions exhibit very nearly, on a small scale, that effect which takes place on an immense scale, by the joint action of the SUN and MOON, in producing the tides of the ocean, I have given them the name of Tidal motions of Conductors, free to move.

13. Now the mechanism which produces the change of figures, from a sphere to an ellipsoid is sufficiently obvious. We have two forces under consideration. 1st. The cohesion or gravitation of the mercurial particles upon each other;—and, 2nd, the disturbing force of the polar wire, as a centre of attraction. As that disturbing force decreases in a certain ratio, as the distances increase, the mercurial particles on the side A, figure 11, nearest to the polar wire, are more attracted by it than those in the centre C of the globule, and those in the centre C, are more attracted than those at F.



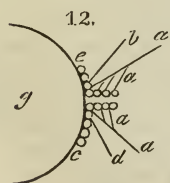
The particles, therefore, at A, rise towards the wire by its direct action, those at F, being less solicited towards the centre of the globule than those at E and B, the former recede from that centre, while the latter seek it.

14. It has been observed, that a true theoretical tide differs in no respect from a wave. Suppose a spring tide actually formed on a fluid sphere, and the sun and moon then annihilated, the elevation must sink, pressing the under waters aside, and causing them to rise, where they were depressed. The motion will not stop, when the surface comes to a level, for the waters arrive at that position, with a motion continually accelerated. They, therefore, pass that position, as a pendulum passes the perpendicular, and will rise as far on the other side, forming a high water where it was low water, and low water where it was high water. And this would go on forever, oscillating in an assignable time, if it were not for the viscosity of the water. Now this theoretical case may be easily shown, for on approaching the positive wire towards the globule of mercury, a particular position will be gained, at which contact will take place, between the protuberant tide on the mercury and the wire. In that moment the cause of attraction is annihilated, the whole current of electricity now passes along perfect conduc-

tors, hence fulfilling the supposed case of an actual annihilation of the sun and moon, at the time of a spring tide. And the same reasoning that held in one case, equally applies in the other; the mercurial tide falls with an accelerated motion, and the line which before was the conjugate axis of the ellipse, now becomes the transverse; a tide being produced at right angles to the former one. But here the strict comparison ends, for as the mercury ebbs from its protuberant position, the metallic connexion breaks, and the wire is again put in action as a point of attraction,—the motion of the ebbing tide is checked,—it flows once more,—once more the metallic contact is complete, and when the tide falls,—it is only to flow again, as long as the battery current passes. Tides take place at right angles to each other, in a series too rapid to be counted, and the whole surface of the mercury is worked into those various and beautiful undulations which have been before referred to.

15. In endeavouring to ascertain the true cause of these phenomena, the French philosophers were, I believe, the first to observe these motions in the water, or other liquid of communication, as if a gentle wind played over its surface, bearing light bodies in its vortices. The explanation of these appearances, I here add, because no one as yet has given it, and it affords an illustration of certain propositions delivered by Sir I. Newton, in his *principia*, concerning the doctrine of pulses in elastic fluids.

16. We have hitherto been considering a globule of mercury, as a substance mathematically fluid. Such, however, in effect it is not, the water in contact with it possesses those properties in a much more eminent degree, so that in comparison with it, the mercury may be regarded, as a solid resisting obstacle. Now about a year ago, I showed that when a voltaic current passes through a system such as this of mercury and water, the capillary pressure on the bounding surface is changed; but, if the attraction of the wire which is introduced into the water, and which is the ultimate cause of this dynamical derangement decreases in a duplicate ratio, it follows that this disturbance of pressure, obtains only to a limited extent on the surface of the mercury; or in other words, the excess of pressure produced by a voltaic current, is not spent equally on all parts of the mercurial surface, but those which are adjacent to the positive polar wire, are more affected than those at a distance. NEWTON has shown (*Pr. v. 2, B. 2, pr. 41*) that if the particles of a fluid do not lie in a right line, a pressure propagated through that fluid, will not be in rectilinear direction, but the particles



that are obliquely posited, have a tendency to be urged out of their position. So the particles *a a a a*, figure 12, pressing on the particles *d b*, which stand obliquely to them, by reason of the shape of the mass of mercury *g*, have a tendency to be urged from their places towards *e* and *c* respectively, and the motion thus produced in a fluid, diverges from a rectilinear progress into the unmoved spaces, and such a pressure taking effect on a liquid free to move, continually return the moving particles, to their first position,

after making them describe an elliptical orbit.

17. It has been remarked, that the basis on which this explanation essentially rests, is that a wire, from which an electric current passes, acts still as a point of attraction; an effect which involves the conducting and other electric properties of the system, on which the experiment is traced. Hence we gain an insight into the cause of the paralysis of these motions, by the addition of certain substances,—the spiral motions going on the surface of

the water, have these explanations complicated with another consideration,—the figure of the mercurial mass.

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*Observations upon the facts recently presented by Professor Olmsted, in relation to Meteors seen on the 13th of November, 1834. By A. D. BACHE, Prof. Nat. Philos. and Chem. Univ. Penn.*

Before proceeding to examine the new facts recently put forth by my friend, Prof. Olmsted, in regard to meteors seen on the 12th and 13th of November, 1834, it will be well to state what is the difference of opinion between us.

Prof. Olmsted I understand to assert, that there was a recurrence of the meteoric display of November, 1833, in 1834, thus verifying a prediction made by him as a consequence of his peculiar theory. With that theory, further than as it is borne upon by facts in regard to the prediction founded upon it, I have not at present any concern. Independently of theory, it would be a very curious fact, if it were made out, that meteoric displays of an unusual kind occurred annually on the same night; and I was induced to observe on the night of the 12th–13th of November, 1834, with reference to facts rather than theory. Prof. Olmsted states his conclusions from observations made at New Haven, in these words: “On the morning of the 13th of November, 1834, there was a slight recurrence of the *meteoric shower* which presented so remarkable a spectacle on the corresponding morning of 1833.”\*

My views, as resulting, first, from observations made at Philadelphia on the morning of the 13th, are, that “there occurred on the 13th of November, 1834, no remarkable display of meteors of the kind witnessed in 1833.” To sustain this, after recording the meteors seen by me on the 13th of November, 1834, I undertook to show, 1. That the meteors which I saw were neither in degree nor in their peculiarities like a portion of the meteoric phenomenon of November, 1833. 2. That they were similar, both in degree and kind,† to common meteors. The small number, and absence of a common radiant, support the first position. The nearness to the number frequently seen at a period of the night, and a period of the year when these meteors are less frequent than early in the morning and late in the autumn, together with the very different points in which their paths, if produced, would have intersected, show the second.

The new facts presented by my friend, Prof. Olmsted, and upon which I now proceed to remark, are classified by him as “foreign testimonies” and “domestic testimonies.” The first are somewhat particular, but the latter quite general. The foreign testimonies alluded to, are those of the Rev. W. B. Clark, A. M. F. G. S., &c., and W. H. White, Esq., both of England. These gentlemen saw meteors on the morning of the 13th of November, 1834.

The opinion of Mr. Clark in relation to the meteors which he saw, is to be found in the same paragraph from which Prof. Olmsted has quoted his

\* Amer. Journ. Sci. vol. xxv. p. 363. Journ. Frank. Inst. vol. xvi. p. 368, in an article headed *Zodiacal Light*, between which and the meteors, Prof. Olmsted’s theory leads him to infer a connexion.

† This term, which I used to denote the peculiarity in regard to the paths of the meteors, has, I find, been misunderstood. I did not mean to express by it an opinion that the meteors of 1833 had a physical cause different from that producing ordinary “shooting stars.”

observations. It is thus expressed: "The coincidence between these and those seen in America and Europe on this day of the month, is curious, *but those which I now mention were electrical, and of no uncommon character.*\* In a subsequent paper, after reviewing the observations made by Prof. Olmsted, Mr. Twining and myself, in America, and by Mr. White and himself in England, the Rev. Mr. Clark thus concludes:† "One fact is at least established by these seeming contradictions, viz. that *common electrical*‡ meteors did appear both in America and England, on the same night, whilst there is no direct evidence to show that any others also appeared."

I have considered the opinion of Mr. Clark respecting what he saw, as the more important, because his description of the direction of the meteors is not very precise. He says they were in the direction of a line from Leo to the star Mizar. He may mean that their paths coincided with this line, or merely that they were parallel to it. Taking the former statement as most favourable to the similarity of this phenomena to that of 1833, it would still, however, be very different from that, however remarkable in itself. That fifteen meteors should fall precisely in the same line, is certainly a curious fact, but as certainly a very different one from the apparent convergence to a single point of the paths of more than 207,000 falling in very different parts of the heavens.

The Rev. Mr. Clark further states, that he saw one meteor which appeared to pass to the south of Ursa Major, and between Cor Caroli and Aucturus, the most northern of these stars being about seventeen degrees greater in north polar distance than Mizar. If this was one of the fifteen meteors before alluded to, Mr. Clark probably intended his description to apply to the general direction, and not to the precise position of their paths. This, however, is not important so far as the inference in regard to the question between Prof. Olmsted and myself is concerned.

The greatest number of meteors which Mr. Clark saw was fifteen in fifteen minutes, or else he only observed fifteen minutes; which is the correct supposition his account leaves doubtful. The portion of the heavens his view embraced is also doubtful: he merely states that he observed from a window. To make the hypothesis as favourable as possible to the number of meteors, we may suppose that he observed but for fifteen minutes, and saw fifteen meteors; that his range of vision embraced not more than one-tenth of the visible heavens, and that meteors fell in equal numbers over an equal space in other quarters. All these assumptions, and they are for the most part gratuitous, would make the number over the whole sky six hundred in one hour, while during the display in 1833, six hundred and fifty meteors§ were counted in about one-fourth part of the sky in fifteen minutes, making upwards of 36,000 in one hour, and this only one hour and a quarter before sunrise.

The observations of Mr. White do not seem to me, any more than they do to Mr. Clark, to support the idea of a recurrence of the meteoric phenomenon of 1833. The number of meteors which he saw was ten in half an hour, being less than the number seen in fifteen minutes by Mr. Clark. The observations were made from windows which commanded a view of the north and east, and supposing that they commanded but one-sixth part of the heavens, and that the meteors were of the same frequency in every part,

\* Loudon's Mag. Nat. Hist, vol. vii. p. 655.

† Ibid. vol. viii. pp. 420, 421.

‡ This term, electrical, is in allusion to his theory.

§ Amer. Journ. Sci. vol. xxvi. p. 367

we should have one hundred and twenty meteors for the whole sky in one hour; one-three-hundredth part of the probable number visible in 1833, at Boston, in one hour. During the display of 1833, ninety-eight meteors were seen in fifteen minutes, the rate being three hundred and ninety-two per hour, within three-quarters of an hour of sunrise.

Neither does it appear that the meteors seen by Mr. White had an apparent radiant. One of the meteors of which he speaks, "glided almost perpendicularly towards the earth: this was succeeded by another of a most brilliant appearance, which took a westerly direction."

The ten meteors to which I have before referred, are said to have appeared between Leo, Virgo and Ursa Major. This place, as assigned in a general description, is a matter of course, since these were the principal constellations within view from the north and east windows from which Mr. White observed. Nothing is said about a radiant, too remarkable a fact to have been overlooked, had it existed.

But the number of these meteors has frequently been equalled, and even exceeded, in cases, between which and the meteors of 1833, no connexion has been claimed. I need only quote a few cases. On August 8th, 1823, Professor Brandes noticed sixty-five in two hours. On August 10th, "one hundred and fifty were noticed in less than two hours, and Professor Brandes remarks that they were obliged to leave many unrecorded."\* During August, 1833, Mr. Espy and myself noted, over one-fifth of the visible heavens, thirty-seven meteors in one hour. We have noted eight in fifteen minutes, six in nine and a half minutes, five in ten minutes; and this at a time of the evening, and at a season when meteors are comparatively infrequent. At other times one meteor only would be seen in half an hour, showing the variable nature of the occurrence, even on the commonest occasions. Prof. Olmsted himself refers to *showers* of meteors seen in *April*, 1833 in Virginia, in England on the *nineteenth* of *November*, in France in *April*, 1833, in August, 1833 in England, &c.

There is no connexion in point of time, between the English observations and those made in America. The meteors seen by both Mr. White and the Rev. Mr. Clark, occurred at a time when meteors were not frequent, even at New Haven.

The "American testimonies" given by Prof. Olmsted would determine the question if it were *did meteors occur on November 13th*, 1834; but upon the one really at issue they do not bear. The authorities, consisting of a member of the Theological Seminary at Andover, an anonymous writer in the St. Louis Observer, and a female servant at Zanesville, give no particulars on which to found an opinion as to the nature of the meteors which they saw. The St. Louis Observer merely states, loosely, that he saw, at five, A. M., in fifteen or twenty minutes, thirty or forty meteors. The accounts want the precision necessary to form any opinion in the case.

In regard to the remarks which my friend, Prof. Olmsted, appended to his facts, it is necessary to observe, first, that in addition to the indirect evidence of no meteoric displays having been seen at eleven military posts from Maine to Florida, six western posts, and five on the northern frontier, and which he notices, I presented other *indirect evidence*, not noticed by him, derived from scientific friends at Wilmington, Baltimore, the University of Virginia, and the University of North Carolina; and *direct evidence*, also unnoticed by him, from observations at New York, Philadelphia, and Nash-

\* On shooting stars, by E. Loomis. Amer. Journ. Sci. vol. xxviii. p. 96.

ville. Further, that a sentinel at Mackinac, where meteors *did* fall in considerable numbers, saw and remembered the fact. My friend states his preference for the testimony of nautical men, and yet of all those who navigated between this and England, on the night in question, not one has recorded observations of any extraordinary meteoric occurrence like that of the 13th of November, 1833.

In the second remark, allusion is made to a record on the minutes of the American Philosophical Society. This record\* is there entered as a "verbal communication in relation to the result of observations on the recurrence of the remarkable meteoric display of November 13th, 1833." This record rests, not on the responsibility of that learned body, but on my own, and I believe I have shown full warrant for it. Records are made of all verbal communications presented to the Society, and among them will be found a reference to the new facts presented by my friend, Prof. Olmsted, as the substance of another verbal communication made by me.

In conclusion, I think the examination of those of the new facts which are susceptible of such a course, has conclusively shown that the meteors referred to in them were of ordinary character. And a comparison of this result with the inferences which I have elsewhere drawn from my own observations, and those of others, leads to the conclusion, that no satisfactory evidence has yet been presented of the occurrence, in 1834, of a meteoric display, which, in numbers, in peculiarities, or in connexion (as parts of the same phenomenon) and extent combined, was such as to connect it with the meteoric display of November 13th, 1833.

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### Bibliographical Notices.

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*The Book of Science. A familiar Introduction to the principles of Natural Philosophy, adapted to the comprehension of Young People. PART III. CHEMISTRY. [Philadelphia, Carey, Lea & Blanchard.]*

The little work now before us is one of a series on Natural Philosophy. It has a merit which is rare in books of its class, that of accuracy. The preparation of elementary works is too often undertaken by the half learned in the subject of which they treat. Hence erroneous, partial, or inaccurate, views are sometimes instilled. It is a high distinction of our time, that men the most eminent in the different branches of science, have applied themselves to the preparation of popular works. The difficulty in such cases seems to be that few are able to come down sufficiently to the comprehension of the general reader. And few stand so high that their reputation may not be touched by treating a subject superficially. The class of works now referred to is however, a different one from that to which the subject of the present notice belongs.

Chemistry is a difficult subject to bring down to the comprehension of the young in a book: it requires experiments to illustrate, and frequent verbal explanations to relieve difficulties. A teacher who would take in hand the Chemistry of the Book of Science, and follow it in his experiments, and accompany it by his explanations, would do a good service to the youth under his charge, for the information is exact and such as he may rely on himself. It is besides generally brought up to the Chemistry of the day.

\* This quotation from the minutes, which are not published, is made by permission of the Society.

If however the work should be placed in the hands of youth without such auxiliary aid, we doubt if they could at all comprehend it, or if they would be at all attracted by the science which it contains. Lively as some portions of it are, the general character is that of dryness. Hard words are not spared, and matters hard to be understood are unfolded. It would in fact, fully employ a teacher's thoughts, and he would be gratified with the task of expounding.

In schools where an elementary course of chemistry is taught by experiment and with verbal explanations, this work will, we are of opinion, be found useful. The typographical execution of the book is good, and the cuts though plain are generally illustrative. B.

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*The American Almanac and Repository of Useful Knowledge, for the year 1836. [Boston, Charles Bowen.]*

This is the seventh volume of a very useful and creditable American work, containing a body of scientific and other useful matter, which must recommend it to very various classes of readers.

The astronomical department of the Almanac is as heretofore under the charge of Mr. R. T. Paine, one of the most zealous of our devotees to this branch of science. Besides the usual valuable matter requiring a yearly change, additions have been made to the tables of this branch, and a table of the moon's librations has been added. The table of longitudes has been corrected in several cases from observations either made or collected by the editor, and we have especially remarked, that the positions given to Charleston, Beaufort, (S. C.) and Savannah, differ considerably from those heretofore assigned. The arrangement of the tables which was made anew last year is continued, and if change of location were not objectionable in a book of reference, we should be disposed to prefer the new arrangement.

Of the astronomical phenomena predicted for 1836, the principal will be a solar eclipse to occur on the 15th of May. The general eclipse will first begin (at 5h. 58.4m. mean time at Washington) at a place in South America, the latitude of which is  $2^{\circ} 9' S.$  and longitude  $76^{\circ} 51' W.$ , and end (at 10h. 48.4 mean time at Washington) at the place in the Mediterranean the latitude of which is  $35^{\circ} 11' N.$  and longitude  $28^{\circ} 50' E.$  The calculations of the general circumstances of this eclipse, and of the beginning, middle and end, &c., for seventeen places in or near the United States, with the approximate result for twenty-four others are given in the Almanac.

The second part of the Almanac, devoted to statistical and other information, contains papers on the statistics of crime in France, on Pauperism in France, on Agricultural and Rural economy, besides a mass of valuable statistical information relating to the United States and to the individual States, to religion and to education. The work contains a distinct head for meteorological information. It has indeed been reproached by a contemporary with containing too much matter, an objection not often to be urged to a work of so moderate a price, and one which needs only to be urged forcibly to induce a most extensive circulation. Such a circulation we heartily wish it may obtain. B.

## Mechanics' Register.

### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1835.

*With Remarks and Exemplifications by the Editor.*

1. For a *Thrashing Machine*; William Loughton, Portsmouth, Rockingham county, New Hampshire, June 6.

This patent is taken for an improvement on that of November 17th, 1834, described Vol. 15, p. 397. The claim now made is very similar to that in the original patent, and does not in any manner allude to new improvements; the patentee says, "the principles I claim as my invention, are the conical ribbed cylinder, and the semicircular ribbed cradle conforming thereto, by which, from the angular position with which they come into action, the hull of the grain is split without injury to the seed." As these *principles* made a part of the first patent, the claim cannot be sustained under the present one, or a man might renew his patent forever. The claim, to have been valid, should have pointed to those improvements only which the patentee has made since November 1834.

2. For an improvement in the *Theodolite*; Samuel Stone, Long Green, Baltimore county, Maryland, June 6.

The patentee states his improvement to be "in the art of measuring distances at one station with a theodolite, or any other instrument by which an angle can be made either perpendicularly or horizontally," &c. The patent, however, is taken for an improvement in the instrument, and not in the art of using it. He says, "the first improvement which I claim is the mechanical addition to the common theodolite, by extending the diameter of the horizontal limb for the purpose of forming a surface as well as a centre on which a circular rim or plate revolves, as already described; and also the application of the logarithmic calculations as applied to the circle, as already described. But I particularly claim the improvement of measuring distances by an angle at one point or station, using the pole or stave, with its graduations, for one side of the triangle."

With respect to its construction and use, the inventor says:

"This instrument embraces all the principles of a modern theodolite; besides which, it contains the following improvements: The first improvement is a circular revolving plate, sliding or resting upon the limb of the instrument, the upper surface of which forms a plane with the upper surface of the limb; on which are delineated a set of mathematical numbers, which supply the place of a table of logarithms, and all other logarithmic tables.

"In the second place, this instrument is so constructed as to supersede the necessity and use of a chain in all cases. The distance of any visible object can be ascertained at one station, as far as the flag staff can be distinctly seen through the telescope of the instrument, to the exactness of chains, links, and decimals.

"It also calculates the latitude and departure of every course run, and the base and perpendicular of all elevations. It further embraces all the fundamental rules of common arithmetic, viz: multiplication, division, single rule of three, interest, mensuration of superficies and solids, gauging, &c.

Any question in plain trigonometry, right angled or oblique, can be solved on the instrument correctly; including all questions that can be performed by logarithms or logarithmic tables. The whole without the use of figures or a mathematical calculation."

The instrument has received the approbation of the New York Institute, the managers of which have awarded their highest premium, a gold medal, to the inventor.

3. For *Extracting Gold from its Ores*; Nathaniel Bosworth, city of Philadelphia, June 6.

"The improvements herein described, for which a patent is asked, consists in the arrangements and connexions by which we are enabled to collect the particles as soon as disintegrated from the rock, thereby preventing their becoming armed with stoney matter as in the old process, which prevented the gold from coming in contact with the mercury. Also, by preventing the gold from parting with a portion of its substance in forming the streak upon rocks in contact during the operation of stamping, which has heretofore been a source of waste. By the old process the gold was necessarily stamped so fine as to flow over the top of the bocard with the water. By the new process the gold is carried out even with the bottom of the bocard, retaining its size and form as when in the matrix. Also the use of *silver or gold plate surface*, by which we obtain a new agent, that of mechanical pressure, in addition to chemical affinity. Should it not be convenient to obtain the precious metals for the amalgamating plates, and a substitute be used, such as brass, copper, tin or bismuth, it will be proper to subject the amalgam to the action of a single acid that will dissolve the baser metal and not the gold; for if tin, zinc or bismuth, or some of the other metals be combined with gold by melting, it then becomes extremely difficult to separate them."

"As other metals than gold and silver may be used, I claim not only their employment for the purpose described, but, generally, the amalgamating upon a hard fixed metallic substance of any kind, quickening the same by the smallest quantity of mercury which will answer the intended purpose of arresting the particles of gold in their passage over it, whereby I expose any required extent of quicksilvered surface, on which the gold will become firmly attached, or the particles effectually united."

Several drawings accompany the specification, and are referred to in it, affording a complete view of the apparatus.

4. For *Constructing Coffins of American or Hydraulic Cement*; Daniel Dayton, Hiram Hoyt and John White, Salina, Onondaga county, New York, June 6.

"This improvement or invention consists in making coffins of the American or hydraulic cement, and that improvement or invention is hereby desired to be patented."

We think that the making of a vessel or box in the form of a coffin, out of a material of which various vessels have been previously made, will neither be viewed as an invention or improvement in the eye of the law, nor do we perceive how such an *invention* could employ the powers of three individuals.

5. For an improvement in the *Truss for Hernia*; John L. Heintzelman, city of Philadelphia, June 6.

"Now all that I claim as my invention and improvement, and for which I ask letters patent, is the mode of placing the metal disk of the pad between the two sheets of caoutchouc, impressed and united as herein described and set forth, instead of placing it, as formerly, behind them, and dispensing with a covering of silk, leather, or any other substance whatsoever; thereby rendering the pad more elastic, more simple and durable, and perfectly easy to be cleansed without difficulty."

The caoutchouc pad is formed by pressing two sheets of caoutchouc, cut to a suitable size and shape, between heated metallic dies, by which the edges of the substance are united, and a proper form given to each side of the pad, the brass plate being enclosed between them, with a suitable tube projecting from the back of the pad, by which to attach it to the spring.

6. For a *Pyramidal Stove*; Thomas M. Southwick, Troy, Rensselaer county, New York, June 6.

This is a sheet iron stove lined in the furnace part with soap stone. The only peculiarity which we see in it, is the forming of an air-tight chamber at the lower part, from which tubes are to ascend up into the furnace. The object proposed is to heat the lower part of the stove by the descent of heated air into the chamber; it will be found, however, that more heat would be conducted down by solid rods than by the air tubes: the contrivance is, in fact, at variance with well known principles.

"The invention claimed and desired to be secured by letters patent, consists in the arrangement and adaptation of the several parts of the stove so as to produce the one described; but I particularly claim the tubes which convey the heated air *downward* into the close vessel below for warming the feet, and the construction of the furnace containing the coal."

The description is very confused and indistinct, and the claim corresponds well with it.

7. For a *Machine for Mixing Mortar and Hoisting Brick*; Jesse Rinehart, Danville, Vermillion county, Illinois, June 6.

A horse power is to be used to turn a cylinder furnished with projecting pins, and revolving within a concave, into which the sand and lime are to fall from a hopper. As in the preceding patent the description is altogether defective. Nothing is said about the construction of the hoisting part; we are only told that "the mortar or brick is hoisted by the same power which makes the mortar, and much in the same way as other hoisting machines." The drawing represents several things not alluded to in the specification.

The claim is to "the arrangement and adaptation of the several parts of the machine so as to produce the one before described, for mixing mortar and hoisting materials combined."

8. For a *Machine for Hulling Clover Seed and Rice*; Winslow Braley and Jeremiah Walker, Phillips, Somerset county, Maine, June 6.

This machine consists of a grater or rubbing board, worked up and down by means of a lever, the seed descending between this and a stationary grater. The graters are made of punched sheet iron, fixed upon wooden cylindrical segments crossing the rubbing boards. The machine is well described, but there is no claim made, although it certainly possesses sufficient

originality upon which to have founded one. Several parts referred to in the specification, have been omitted in the drawing; it is therefore defective, as it would not be a sufficient guide to a workman about to make the machine it represents.

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9. For a *Thrashing Machine*; Hugh and Isaac W. Edgar, Wayne county, Ohio, June 6.

This is called a "Portable Grain Thrasher," but a horse power, which is certainly a separate and distinct machine, is also described in the same specification. The thrashing machine works by a cylinder and concave, and the general construction of the horse power is the same with many others.

"We claim, as our improvement, the peculiarly simple and substantial construction of the frame of the horse power and machine. The cheap and durable form of the master wheel; the proportionate shape of the bevil wheel, which gives it greater strength in proportion to the weight than the usual plan. The square pieces of iron with pins on the corners in ratchet joint, which are easier made, more substantial, and work with less friction at a great angle than those used heretofore. The form of the bar and bar tooth cylinder, the teeth of which are not liable to fly out by the centrifugal force of the cylinder when in motion. Placing wood or flat bars between the bars in the concave, which leave greater space for the grain. The regulating the concave to or from the cylinder with keys, to suit the state of the grain. The ratchet wheel shaft passing through the machine, so that the tumbling shaft may be attached to either end to suit different situations. Placing half the gearing on the machine, which reduces the motion of the tumbling shaft, and simplifies the horse power."

If the patentee can sustain all the foregoing claims, together with an exclusive right to his two machines, he will do more than we believe he can accomplish.

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10. For a *Cooking Stove*; Elijah Skinner, Sandwich, Strafford county, New Hampshire, June 12.

This stove is to be set in a common open fireplace, and differs so little in its general arrangements from some others, as not to require or to admit of special description. The claim is to "the particular arrangement and effect of the flues, funnels, damper and oven, and the appendages for letting off the steam; and the application of the whole to the common open fireplace, as before described."

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11. For an improvement in the *Common Fireplace*; Ira A. Bean and Elijah Skinner, Sandwich, Strafford county, New Hampshire, June 12.

A box is to be formed across the fireplace somewhat like a hollow iron back-log; below this box or furnace there is to be an air chamber, and a plate is to rise vertically near its back edge, so as, with the chimney back, to form a flue for the escape of smoke. In the top plate of the box there are openings for cooking utensils; there is an opening also for admitting fuel, and tubes to let heated air into the room, which, however, will never produce this effect, as the draught will be the other way. The claim is to "the construction of the box in the hearth, and the arrangement and application of the same, with the flues, funnels and false back, to common open fireplaces; the object of which is to save room and fuel, furnish a cheap and

convenient apparatus for cooking, and at the same time avoid the impure air occasioned by close stoves, and the steam from cooking stoves."

The whole of the above named objects will not be attained by means of this contrivance; we do not think that there will be any special convenience in its use, and it certainly will not be economical when intended for heating in the place of a well constructed close stove.

12. For a *Thrashing Machine*; Thomas Rucker, Jr. of Murphreysborough, Rutherford county, Tennessee, assignee of Pendleton Check, of the same county, June 12.

In this machine there are two revolving cylinders, one placed over the other; the upper one is furnished with knives or cutters, acting against an opposing fixed cutting edge, and these together operate in the manner of shears. The grained ends of the sheaves are fed to this cutting apparatus, and the pieces cut off fall between a thrashing cylinder and a concave, grooved from end to end, in the form of saw teeth, by which the grain is thrashed out. The claim is to "the manner of separating the heads of wheat or other grain from the straw, previous to thrashing it by the combination of machinery herein specified and described." It is said that in this instrument "the wheat is thrashed out more completely, and with far less labour than in those machines where the whole sheaf is operated on."

13. For a *Plat-form Balance*; Alexander Bliss, Benson, Rutland county, Vermont, June 12.

"What I claim as my own invention, and not previously known in the above described machine is,

"*First*, The arrangement of the levers, by which they form parallel lines and right angles, in the construction of the machine.

"*Second*, The application of crank suspensions attached to the axle.

"*Third*, The described swing and its crank suspensions.

"*Fourth*, The employment of the swings in front and rear of the machine described in the specification, upon which the short arms of the upper levers rest."

Those acquainted with the platform balance will see from the foregoing, that there is nothing essentially differing from it in the action or construction of the machine proposed by this patentee. We are not aware that any advantage can result from arranging the levers all at right angles, and think that in this and some other points the change is in form rather than in substance.

14. For an improvement in *Bridges*; George Law, Easton, Northampton county, Pennsylvania, June 12.

The object proposed to be attained by the patentee is without lessening their strength, to give increased height to wooden bridges, thereby admitting of the passing of high loads, and of locomotives without lowering their chimneys. The framing of the bridge is to be the same as that now most commonly adopted, namely, double posts passing from one chord to the other with diagonal braces between them, thus forming a truss frame. The patentee says, "what I claim as my improvement and invention in the above described mode of construction, is limited to the additional stories, or tiers, of truss frames above the first or lower-most one, (which one has been used before.) I do not claim the principle of sloping the braces at right angle,

nor the use of the arch, but simply the repetition or additional combination attained by adding tier upon tier as above described."

There certainly is but little, if any, invention in the foregoing plan; and, in most cases, the increasing the height of a bridge is objectionable from its greater exposure to injury by wind; independently of this consideration, we do not apprehend that any builder would find it difficult to increase the height of such structures without the fear of weakening them.

15. For a *Cheese Press*; David Phelps, Bangor, Penobscot county, Maine, June 12.

A windlass crosses the frame of the press, near to its bottom, the ends of the shaft passing through the cheeks so as to draw upon ropes, which are to communicate the pressure; a rope from each of these projecting ends is attached above to a bent, or progressive, lever, working upon suitable fulcra, and bearing at their inner ends against a follower, which they force up; they have friction rollers on their ends to enable them to operate freely. There is no claim made, although the patentee says that it "has advantages over all others in use, for reasons, which may be seen at a single view." This may be the case, but we do not think so, although we have no doubt that it will answer the purpose intended in all its parts; but in all its parts it is not new.

16. For an improvement in *Fireplaces for Grates to burn anthracite*; Joseph Snyder, Philadelphia county, Pennsylvania, June 12.

The greater part of this fireplace is proposed to be made of cast-iron; the bottom of it is formed of two parallel plates, two or three inches apart, and constituting a part of a circulating flue. This may stand upon feet, raising it a little from the ordinary hearth, and on it rests the back and jambs, the back also being formed of double plates, connecting with those at the bottom. The grate is situated as is usual in open fireplaces, and above it are double top plates also forming a flue between them. Hollow columns at the corner of this fireplace, in front, connect the hollow hearth with this hollow top, the back end of which passes into the chimney, in the manner of a Franklin stove; there is a damper situated on the lower plate of the upper base, which being opened allows of a direct draught into the chimney, but when closed, causes it to circulate around the whole structure. The grate is lined in the usual way, and supposing the damper to be closed, the draught is over the sloping back into the back flue, then downwards between the two back plates, then forward in the hollow hearth, and upward through the columns into the cap flue, and back into the chimney. The claim is to "the principle of diffusing the heat of an open fireplace or grate to the hearth and parts situated below the fire, by a descending and ascending flue, or flues, and double hearth, as set forth and described."

17. For an improvement in *Stoves*; John C. Parry, Pittsburgh, Pennsylvania, June 12.

Although many patents are taken for trifling things, the one before us may be considered as standing alone in its own littleness. The whole thing proposed is to cover the rods used for connecting the tops and bottoms of Franklin, ten plate, and other stoves, by half columns of cast iron.

18. For a *Saw Set*; Herrick Aiken, Dracut, Middlesex county, Massachusetts, June 12.

The description of the saw set is very imperfect, or the instrument itself is strikingly so. There is to be a small piece of steel with a rounding face set in an iron bed, and upon this the setting is to be effected. Two horns, or projecting pieces on the bed, are employed to hold the said blade in its place, and there is to be a regulating guage, which in the drawing is represented as having teeth on it like those of a saw, and we are told that "the set of the teeth is performed by a hammer, or hammer and punch. The claim is to the foregoing parts." We know something about saws, saw sets, and saw setting, but should be at a loss, with all the helps before us, in attempting to construct and use the foregoing instrument.

19. For *Splitting and Paring Leather*; Herrick Aiken, Dracut, Middlesex county, Massachusetts, June 12.

This machine is for cutting or skiving leather after it has been cut in strips or pieces to the required length and width. Like the foregoing, it is but imperfectly described, and could not, therefore, be carried into effect without the aid of invention. A cutting knife is to enter horizontally along a cast iron frame, and what is called a *revolving regulator*, which we are told "is an inclined, hollow semicircle," is placed above the knife, extending between two upright studs, to which, we suppose, it is attached by gudgeons, placed eccentrically, so that when turned down over the edge of the knife, its distance therefrom may be regulated by its eccentricity, and thus serves as a guage for different thicknesses. There are some other parts for which we could suppose a use, and a mode of fixing, but this is rather a departure from our general design. Very simple instruments have been long in use for the same purpose, and although this is called an improvement, the term must be taken in its technical acception only, meaning that it is not precisely like those which have preceded it.

The claim made, is to "the arrangement and adaptation of the several parts of the machine so as to produce the one before described, and particularly the method of confining the knife, and the construction of the regulator." The former part of the claim may be tacked on to any specification; the latter portion is to things not properly described.

20. For an improvement in *Pumps and Fire Engines*; Henry Gates, Northampton, Hampshire county, Massachusetts, June 12.

The body of this pump is to be a short cylinder or drum, its axis standing horizontally, and truncated or cut off on its upper side so as to reduce it to about two-thirds of its cylindrical capacity; this upper part is covered, water tight, by a horizontal plate. An axis passes through the cylinder, and has attached to it two buckets or leaves, standing at right angles to each other, fitting the lower part of the cylinder and the two heads, water tight, to effect which they are made of durable metallic plates, screwed together with packing between them. Each of these leaves has a valve opening outwards, or towards the upper plate of the chamber.

The upper part of the drum is divided into two chambers by a fixed partition descending from the upper plate to the upper side of the vibrating axis, against which it is to fit water tight. There are two valves opening upwards on the top plate, one on each side of the partition, and these are both covered by a conical delivery pipe, by which the water is to be con-

ducted as required. The receiving pipe descends from the bottom of the chamber into the reservoir, or chamber.

The axis is to be made to vibrate about a quadrant of a circle, and those acquainted with hydraulics will see, that if the instrument be in good order, water will be raised by it. The construction of a pump, operating as described, is claimed. We could point to very similar plans of pumps, but we do not think it necessary to touch this point. Such pumps, if made with extreme care, will work promisingly at first, but they will soon go out of order. When in the best condition, we do not believe that such a pump is equal to the common piston and cylinder, the direction of the water being quite as much changed in it.

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21. For *Heating Apparatus*; Robert Rogers, South Berwick, York, county, Maine, June 12.

This apparatus, we are informed, produces radiated heat, steam heat, and heated air at the same time, which are conjointly to be employed in the heating of buildings. The stove or furnace part may be said to consist of three concentric cylindrical vessels; the innermost of these is a circular pipe, like a stove pipe, which is to receive cold air at its lower end, below the ash pit; its upper end supplying lateral pipes with heated air at any convenient height above the fire chamber. This pipe, to the height of the fire chamber, is surrounded by a double cylindrical boiler which forms the inner wall of that chamber. The fire chamber is formed by a second double cylindrical boiler, placed at a proper distance from the former, and of the same height with it, and which is also the outer wall of the chamber, occupying the place of the ordinary lining of a cylinder stove; the grate bars and ash pit are formed as usual; and there are cold water and steam tubes leading into the boilers. The smoke pipe surrounds the air pipe, being reduced in its diameter by the conical form given to the stove above the fireplace.

The patentee believes that this stove will be very economical, producing a very large portion of heat from a small quantity of fuel, and as he does not point out any particular part of it as his invention, he appears to think that the whole arrangement is new; this, however, is a mistake, concentric cylindrical boilers forming the walls of the fire chamber having been repeatedly employed. Had we time to dwell upon it we could easily point out what we consider as great practical objections to the contrivance.

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22. For an improved *Wind Mill for Raising Water* to set machinery in motion; David W. Hurst, Newbury, Essex county, Massachusetts, June 12.

How much the patentee is mistaken in his ideas and expectations as regards this contrivance, will be apparent from his own words; we therefore give what he himself says; a procedure the fairness of which he will not gainsay.

"This invention, it is believed, possesses advantages above all other machines now in use, inasmuch as with a small breeze of wind a crank placed at the upper part of a common windmill, will be set in motion, and being connected with machinery in the windmill, embracing four pumps or engines also connected, will raise from a pond, well, or spring of water, into a reservoir placed in or near the mill, as may be convenient, a sufficient quantity to set in motion any variety of wheels and machinery required for grinding,

and for all other purposes for which such machinery is used by cabinet makers, and in other manufactories, being conducted from the reservoir on to an overshot wheel by common pipes; and possesses the important advantage of being set in motion by a slight breeze of wind, bringing into use the full power of the water upon machinery which may conveniently be placed under any building in which it may be required to be used."

The drawing represents a windmill working four force pumps to drive the mill wheel. If the thing was good for any thing it was not patentable, as the raising of water by windmills for various purposes is a very old invention; but the whole proposition shows an entire want of knowledge upon the subject.

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23. For a *Mortising Machine*; Jonathan Page, Hennike, Merrimac county, New Hampshire.

There is, of necessity, a considerable resemblance among the various mortising machines which have been patented, their differences consisting in a more or less convenient mode of arraying the parts; all we shall give relating to that before us is the claim.

"Your petitioner claims the construction of the frame for receiving the piece to be mortised, with a movable *rest* and *guard*, different from any in use, whereby materials of different sizes may be more conveniently mortised, and wheel hubs, in particular, of all sizes, are mortised by the use of a cheap and simple carriage for confining them. He also claims the use of common chisels in the operation of his machine, and the cheap and simple construction of the whole."

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24. For an *Oven*; Samuel Pollard, Bucksport, Hancock county, Maine, June 12.

A cylindrical sheet iron oven is to be placed in the chimney of a common open fireplace, its front resting on the iron mantel bar, and its back end being supported in any suitable way at the back of the chimney. An additional flue is to be made under the oven, just above the fire, to heat the back end of the oven more effectually. The contrivance has little or no novelty, and is very far inferior to some similar inventions. It may be put up cheaply, but that, alone, is not a sufficient recommendation. There is no claim made.

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25. For a machine for *Shaving Staves, Heading, and Shingles*; John Everhart, Wayne, Warren county, Ohio, June 12.

This machine operates much in the same way with some others, that is, the stave or other article to be shaved is held down by a pressing roller, and is forced between cutting knives by means of a lever acted upon by a windlass. The claim made is "to the use of the lever geared as herein described, operating in combination with the knives and other part, in the manner, and for the purposes herein set forth." We think that there are certain parts of the machine which might have been specially claimed, in addition to the manner of acting upon the lever, and they might be more safely depended upon than the general action of the machine.

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26. For a *Machine for Shelling and Grinding Corn*; George M. Weaver, Montgomery Square, Montgomery county, Pennsylvania, June 12.

The shelling is effected by means of a revolving cylinder, the corn being fed in by hand; the feeder, which reacts against the cylinder, has some peculiarities in its construction, but the whole machine does not essentially differ from some others. The grinder is merely a cast iron frustrum of a cone, furrowed on its smaller end, and on its edges, which revolves in a corresponding cast iron pan or box. The claim is to "the construction and arrangement of the feeder, operating with the cylinder, in the manner described; and also the construction of the grinder, by which it is made to grind on the conical and front surfaces at the same time."

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27. For *Wooden Hames*; Sereno Norton, East Bloomfield, Ontario county, New York, June 12.

These hames are to be made of any hard close grained wood, and are to be formed much like the horse collar, for which they are to operate as a substitute. The mode of uniting them together by straps, and of attaching the gearing to them, with some other things relating thereto, are clearly enough described, and must be considered as altogether new in every part, as there is no claim.

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28. For a *Spring Seat Riding Saddle*; Jacob G. Patmer, Harvey Beard and Anthony Beard, Greenville, Augusta county, Virginia, April 12.

*Claim.* "Now we do not claim as new in the construction of spring seat saddles, the application of a spring to the head of the tree, nor a spring of zig-zag or W shape, as applied to this purpose. But what we do claim as new, and our invention is the form and manner of constructing the frame and attaching the spring thereto, being curved so as to conform to the gullet of the saddle, and being attached to the tree by straps and webbing, as described. We also claim the application of similar springs to the girth, or girths of the saddle, and also the iron horn secured to and covered as herein described and set forth."

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29. For a *Machine for Propelling Machinery by Weights*; Elisha Turner, North Pownal, Cumberland county, Maine, June 12.

We will present an extract from the so called specification, which, although aided by what is called a drawing, leaves the inquirer as completely ignorant of the intentions of the patentee, as though they were intended to be concealed. We guess, however, that the instrument is intended to *gain power*, although there is not even an attempt to make known how this is to be done.

"*OPERATION.* The weight being wound upon the loose barrel by manual or other power, the catch is thrown into the ratchet wheel by a spring made fast to the wheel fixed to the axle. The pinion on the end of the axle works into a cog wheel, this again into the cog wheels that convey the motion to any object required to be put in motion."

"The *invention* here claimed, and desired to be secured by Letters Patent, consists in the arrangement and adaptation of the several parts of the machine before described, for propelling machinery by weight.

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30. For *Apparatus for Cooling Water and other Liquids*; John Waring, Port Tobacco, Carolina county, Virginia, June 12.

A vessel, like a jar, for containing water, is to be placed within a wooden

box, and surmounted with *pulverized charcoal*; a second vessel containing ice is to be let down into the jar of water, and the latter when refrigerated, is to be drawn off by means of a cock.

A claim is made to "the arrangement and adaptation of the several parts of the apparatus for cooling water and other fluids." In which arrangement and adaptation there is neither improvement, invention, or discovery, if originality is considered as making a component part of these things.

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31. For apparatus for *Hoisting and Delivering Burthens from Ships*; Barnabus Pike, city of New York, June 12.

A frame is to be made by connecting two stout pieces of timber, sixteen or twenty feet long, by cross timber mortised into their ends. The long timbers for a railway upon which to support a carriage, which runs upon friction rollers on their upper edges. Stout legs are framed into the lower sides of the rail timbers, the carriage has a block and tackle attached to it, by the aid of which, and a windlass, the goods are to be raised from the hold of a vessel. The carriage is then moved along the rails, which extend on to a wharf, and the packages landed. The claim is to the carriage as above described and applied, and the principle and mode of carrying and delivering the burthens."

The whole is clearly described and represented, and at certain periods we have no doubt that such an apparatus will be very useful, but the rise and fall of the tide must, in most places, very much interfere with the employment of it.

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32. For *Antifriction Wheels*; Julian Nicolet, Pittsburg, Pennsylvania; an alien who has resided two years in the United States, June 12.

The wheel used is that of Mr. Ross Winan's, in which the axle, the friction of which is to be relieved, rests upon the inner periphery of a flanged friction wheel. The patentee says, "Now I do not claim to have invented the friction wheel described herein, but of its application to the specific purposes herein set forth," that is, to the shafts of water wheels, fly wheels, and paddle wheels, Mr. Winan's having applied them to rail road cars. Be it remarked however, that Mr. Winan's patent has not expired, nor has it been repealed, and the friction wheel itself, therefore, vests in him, and no one can take it from him under the pretence of applying it to axles of a kind differing from those to which he applied them.

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33. For a *Bee House*; William Groves, Harrisburg, Dauphin county, Pennsylvania, June 12.

Houses, or large hives, for the more convenient management and security of bees, have been variously constructed by apiarians, several of which have been made the subject of patents. In that before us there are some variations of form and management, the absolute value of which is a question of experience, and as we perceive but little of originality, and have a long list to go through this month, we shall not give the claims or attempt any description.

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34. For a machine for *Shaving and Jointing Shingles*; Samuel B. Chapman, Camden, Gloucester county, New Jersey. First patented March 15th, 1834, re-issued on an amended specification, June 12th, 1835.

*Claim.* "What I claim as my invention is the manner of fixing the knives within the iron frame; and the giving to one or both of them a vertical motion only, for the purpose, and in the manner, or upon the principle, herein set forth. I also claim the use of rollers, or segments of rollers, to continue the pressure upon the shingle after it has passed in part through the knives."

As this patent has been before noticed, it is not necessary to add any thing in this place to the claim now made.

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35. For a *Winnowing Machine*; Jeremiah Nichols, Chestertown, Kent county, Maryland, June 15.

This winnowing machine is said to be like most others, excepting that leather is nailed on to prevent the escape of wind, and one or two other trifling additions made which we shall not take the trouble to describe.

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36. For a *Mortising and Tenoning Machine*; Joseph H. Darby, Leominster, Worcester county, Massachusetts, June 15.

A very brief description is given of this machine, which is so similar to others that the *inventor* ought certainly to have pointed out its novelties; he, however, has failed to do this, and we have failed in the attempt to discover them; there is no claim to any part of the affair. A vertical shaft, capable of swivelling, when required, receives at its lower end, the chisel by which the mortises, or tenons, are to be made. A crank shaft, carrying a fly wheel, is to move the shaft up and down, and is itself made to revolve by means of a second crank, and a treadle. The stuff to be operated upon is placed upon a regulating shifting bed. The drawing shows two forms of chisels, but we do not hear any thing about them in the specification.

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37. For a *Machine for Washing and Churning*; Charles Otis, Finksburg, Baltimore county, Maryland, June 15. (See Specification.)

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38. For an *Auger*; William Jones, Portsmouth, Norfolk county, Virginia, June 15.

The specification of this invention is brevity itself exemplified; it consists of the following words. "This improvement is a hollow auger made so as to embrace the bolts or fastenings in ships or vessels, and to cut the wood from around them, by which means the plank, &c., can be removed, without the delay, trouble, and expense, usually required by splitting them out."

In the drawing, the auger is represented as twisted like the ordinary screw auger, but capable of allowing a bolt to pass within it. This must be a very useful thing, and, so far as we know, it is new.

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39. For a *Paper Ruling Machine*; James C. Teasdale, Dansville, Livingston county, New York, June 15.

It is said in the claim that this invention "consists in having one additional cylinder, apron, and strings, by which the paper is ruled on both sides as before described;" which description fails altogether in its professed object, being drawn up without any apparent knowledge of the subject.

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40. For a *Machine for cutting Sausage Meat, and stuffing Sausages*; Abraham and John Keagy, Franklin county, Pennsylvania, June 15. (See Specification.)

41. For an *Undershot Wheel*; Ebenezer Cochran, Gibson county, Indiana, June 15.

This is an old, and good-for-nothing contrivance. The buckets are all to swivel on pins near the periphery of the wheel, and we are told, and that not for the first time, that "A wheel thus constructed with floating and folding buckets, will run either wholly or partly under water without difficulty; and when the water has lost its force upon the buckets they will float and fold round on their pivots, with but little friction, weight, or obstruction, until they come on to the pins or cleats."

We could, with a little trouble, point to precisely the same thing; our remarks on the water wheel noticed at p. 236, vol. xi., apply sufficiently well, although the cases are not perfectly analogous.

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42. For an *Accelerated Spinner*; Leonard Norcross, Dixfield, Oxford county, Maine, June 15.

A wheel of about a foot in diameter is to work into an endless screw, which takes the place of the ordinary whirl upon the spindle. It will be needless to contend against the novelty of this mode of obtaining rapid motion, and every one acquainted with machinery will be aware that rapid destruction will also be insured, from this excellent mode of increasing friction.

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43. For *Raising Stumps, Rocks, &c.* from the ground; Leonard Norcross, Dixfield, Oxford county, Maine, June 15.

A tripod is to be made which is to be placed over the stump, &c. to be raised. A screw, standing vertically, passes through the cap of the tripod, and, at its lower end, has chains, hooks, &c. by which to hold on to the stump. A sweep, or lever, is to be drawn round by a horse, a nut on the inner end of the lever raising the screw; no provision is made to prevent the turning of the latter with the nuts.

We should think the claim just as legitimate to raise stones by a hand-spike, as to raise them, and other articles, by the most simple application of the screw. That such a machine properly braced, and upon firm ground, might be made to raise stumps, &c. there can be no doubt, but excepting the clearer of land can contrive to carry his stumps to the machine, he will find no small difficulty in carrying the machine from stump to stump, fixing it with sufficient stability, and obtaining a place for his horses to walk upon.

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44. For *thinning Cotton Plants*; Jordan Gatling, Murfreesborough, Hertford county, North Carolina, June 19.

A kind of instrument resembling a double wheeled plough is so constructed as that the wheels may straddle the cotton rows. One of the wheels has cogs on its inner face which take into a pinion, or trundle, on a horizontal shaft, revolving lengthwise of the machine, and carrying two hoes, or one, as may be desired, on the ends of arms, for thinning the cotton; a coulter and horse hoe are fixed on to each side rail, for siding up. Some directions are given respecting the use of the machine when the cotton may be unequal in thickness; but upon the whole its action is not rendered clear. The claim is to "the manner in which I have combined the operation of the wheels and hoes in the interior of the frame."

45. For a *Machine for Thrashing Clover Seed*; John P. Ridings, Hillsborough, Highland county, Ohio, June 19.

In this hulling machine the seeds are to be rubbed between a cylinder and concave, and the fixing of the latter so as to be borne up by springs is all that is claimed. We apprehend that this claim has been before made, or the method of doing it described, at least ninety and nine times.

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46. For an improvement in a *Forge and Bellows*; John C. Concklin, Peekskill, West Chester county, New York, June 19.

“The principle of this invention consists in the combination of a Smiths’ forge, made of cast metal, with a double bellows placed underneath the bed of the forge; the bellows being of nearly the same dimensions in square, or horizontal measurement, as the bed of the forge. The forge, however, may be sustained on an iron frame work, so constructed as to be portable when the combination is made sufficiently light.”

The middle board of the double bellows is to be placed obliquely, so that the movable boards may rise in reverse direction; this, we suppose is to save room. The forge back, bellows lever, &c., are described, but such forges, with the bellows beneath the fire, the greater part being made of cast-iron, are not novelties. We have one which was imported from England twenty years ago; and others very similar have been patented in the United States.

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47. For a *Hinged Boot Cramp*; Nathan Ayer, St. Johnsbury, Caledonia county, Vermont, June 19.

Although hinged boot cramps are very common things, the patentee describes his, which he does with sufficient clearness, without making any claim. He merely informs us that “its peculiar utility and improvement is shown in its application to use. Having suitably blocked out the leather to be cramped, throw the leg and foot of the cramp, by means of the hinge, as near as may be in a straight line. fasten the leather around it in the proper place by slightly sewing the opposite edges, then raise the leg and latch it, insert the wedge at the toe; then by turning the screws on the bottom of the foot, at the heel and back, the leather to be cramped will be immediately compressed into the desired shape.”

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48. For *Xylographic Check Plates*; Charles C. Wright, City of New York, June 19.

The plate from which notes, or checks, are to be printed is to be covered, by means of an engraving lathe, by transferring, or otherwise, with a very light pattern, consisting of close, but fine, lines. From this the paper is to be printed, say of a light blue, pink, &c. The standing words may then be printed of another colour by any of the known methods. Should chemical means be resorted to for the removal of the fine ground, no human ingenuity, it is said, will suffice to restore and re-unite the lines; and to transfer the two kinds of printing lithographically, will be equally impracticable. When used without the printing of standing words, any erasure on the fine ground will be perfectly apparent.

“The invention consists in the prepared ground covering of paper to be used for securities written in whole or in part, with or without standing words in the same, of different colour from such ground, substantially as above described.”

49. For a *Brick Machine*; T. Miles Bannister, Phelps, Ontario county, New York, June 19.

This is said to be an improvement on the machine called "Rising's Columbian Brick Maker," which, it seems, was a common pug mill for mixing the clay, the tub in which the vertical shaft, with its knives, revolved, being cylindrical.

"What I claim to have invented as an improvement on Rising's machine, is the tub or cylinder being larger at the bottom than at the top; the circular scrapers attached to the bottom of the shaft, the two pistons, and the manner of working them; the moulds, the manner of working them, and the mode of casting them off to right and left by means of a lever."

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50. For *Pistons for Steam Engines*; Benjamin Wright and George Kitchen, Calhoun county, Michigan Territory, June 19.

This is a worthless contrivance, lamely described. The piston is to have six, or any other number of vertical rods extending from one head of it to the other, and between each of these there is to be a bellied friction roller, so as to form a circle of them fitting the cylinder, to take off friction. The other part of the piston is to be packed with hemp, or cork.

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51. For a *Mortise Lock and Latch*; John G. Hotchkins, New Haven, Connecticut, June 19.

This is a kind of lock, or latch, somewhat similar to several which have been patented within a few years, excepting that before us is claimed to be new in the forming of the case and tumbler as described. To ascertain the peculiar difference between this and some others, would require more time than we can bestow upon the subject. The drawing does not make this point clear, for although it is good enough as a picture, it gives no sections, makes but three references, and that to parts partially obscured.

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52. For an improved mode of *Fixing Tubes in Steam Boilers*; John Goulding, Boston, Massachusetts, June 19.

The tubes for the passage of heated air, or water, which pass from head to head, or from one part of a steam boiler to another, are to have tapering male screws cut on each end; one of these is to be larger in diameter than the other, so that the smaller screw at one end, and the tube also, may pass through the hole made for the larger screw. The larger end may be upset, or increased in size in any other way. The screws are to be tapering, and must be cut with such truth that they will enter and tighten up at the same time. The claim is to this mode of inserting tubes.

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53. For a *Machine for Boarding and Softening Skins*; Eli Kendall, Ashby, Middlesex county, Massachusetts, June 19.

The mode of softening skins which has been hitherto followed, is to rub them with an instrument consisting of a board faced with cork, and having a strap across the back, in which to insert the hand. In the machine before us, there is a sort of rubbing board, the lower side of which acts upon the whole skin at once, it being doubled, with its polished side inwards. We cannot, without the drawing, give a full description of the machine, and it is not, in fact, very clearly illustrated. There is no claim made, the

whole machine being considered as new. We are told that, by its means, one man can perform what has been accounted the work of three.

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54. For a *Portable Boiler*; Anson W. Spenser, Cazenovia, Madison county, New York, June 19.

Boilers are generally made with the design of saving heat, but that before us is well adapted to the wasting of it, which it will do most effectually. The drawing represents a boiler something like a coffee pot, but with the smaller end downwards. An interior fire tube runs from bottom to top, perforating both, so that there may be an ash pit below, and that the draught may be increased by adding a pipe on the top. The fluid is, of course, to surround the fire. Of what use the thing is to be we are not told, nor will this soon be discovered.

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55. For a *Machine for Cutting Grass*; Isaac Sturdevant, of Portland, and John Holmes, of Harrison, Cumberland county, Maine, June 19.

Four scythes are to be made to revolve horizontally on a vertical shaft, by gearing from the wheel axles. The general plan is one of the most common for such machines, is imperfectly described and drawn, and there is no claim made.

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56. For a *Machine for Planting Cotton*; Jordan Gatling, Murfreesborough, Hertford county, North Carolina, June 19.

Machines for planting seeds are very numerous; the one before us consists of the various apparatus for opening the ground, dropping the seed, and closing the furrows, and differs but little from others. The claim is to that part of the machine which performs the operation of distributing the portions of seed intended to be dropped from the first hopper to the second, and consists of the combination formed by the slide board attached, as described, to the hopper and moved from side to side by the shaft suspended from the brace by the eye, and working with the slide board by means of the pivot, or pin; also, the use of the second hopper below, adjusted with the hole through the beam.

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57. For a *Smut Mill*; John Card, Gainsville, Genesee county, New York, June 20.

The patentee denominates this an "Elastic, Accelerating, Smut Mill," and furnishes a description of much length and particularity. A vertical shaft is to carry a cylindrical rubber, which may be two feet four inches high, fifteen inches diameter at top, and eighteen at bottom. This is to be surrounded by a stationary sheet iron case, punched from the outside so as to constitute it a concave rubber. The inner, or revolving, cylinder is also to be converted into a grater by covering the ends with punched sheet-iron, and the sides with strips of leather, into which nails, or tacks, are driven from the inside, so as to form a kind of elastic card. Instead of this, however, it is proposed sometimes to cover the outside with pointed cast-iron staves; the term "elastic" will, in this case, not very aptly apply.

"What I claim as my own invention, and not previously known, in the above described machine, is the manner of constructing the cylinder in the two different ways herein above specified, together with the principles of the operation of said machine, it requiring less power to propel it, and being

used with greater safety, being less liable to generate heat, than any machine of the kind before known or used. I also claim as my invention, the manner of constructing the concave hereinbefore mentioned."

The machine is, substantially, so like a host of others that it would be no easy task to make out a claim which should not be too broad.

58. For a *Stove*; James Atwater, New Haven, Connecticut, June 20.

We are told by the patentee that "this improvement consists in certain alterations of, and additions to, a common furnace stove used to burn hard coal, for the purpose of retaining and diffusing the heat of the fuel burned therein in a convenient and economical manner."

Those who are acquainted with the construction of Spoor's parlour stove, (see vol. 16, p. 81,) will easily understand Mr. Atwater's, as it is precisely the same thing, changed only in form. The furnace part is the common cylindrical stove, with the four flues of Spoor's stove, forming four separate columns, the stove and columns extending from a quadrangular base containing the ash pit, and side flues, to a quadrangular cap, or entablature properly divided, and supplied with slides or dampers to cause the heat to circulate down the front and up the back columns, or to admit it directly to the escape pipe.

The patentee disclaims the invention of the individual parts, but claims as new "the above described combination and arrangement to accomplish the above mentioned purposes."

59. For a machine for *Mixing Mortar and Pulverizing Clay*; John Everhart, Waynesville, Ohio, and Lewis Swimley, Washington city, D. C., June 20.

We have before us, in Rees' Cyclopaedia, a very perfect description of the machine here patented; it is there described as it was used seventy or eighty years since, but had then no claim to novelty, its construction and use being of remote antiquity. See the article *Pottery*, Rees' Cyclopaedia, vol. 29.—We shall only copy enough from Rees, fully to supply the place of this new specification.

"The clay is thrown into a cylinder of cast metal, four feet high and twenty inches in diameter. In the middle of this cylinder runs a perpendicular shaft with knives as radii at right angles to the shaft. These knives are so arranged upon the shaft that their flat sides are in the plane of a spiral thread, so that by the revolution of the shaft the knives do not only cut every thing in their way, but constantly force downward what may be in the cylinder, agreeably to the nature of the screw; another set of knives is inserted in the interior of the cylinder, and extends to the shafts in the centre."

The only consolation we can offer to the patentees is that they are not alone in their disappointment, the same kind of machine having been repeatedly made the subject of a patent by other pretended, or imaginary, inventors.

60. For a machine for *Pressing Brick*; Wm. Wadsworth, Hartford, Connecticut, June 20.

This improvement is said to consist in a combination of machinery to effect a new purpose; the respective parts of which machinery may all have been individually used for the same or other purposes.

It is a toggle joint press, bearing a very considerable resemblance to other toggle joint presses, which have been employed for the same purpose.

We do not think that its new arrangements are so characteristic as to "distinguish it from all other things before known or used," without some specific pointing out of its novelties.

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61. For a *Cooking Stove*; Le Grand Fairman, Medina, Orleans county, New York, June 26.

There is not any thing special in this stove, entitling it to particular notice. It is to have two ovens, one on each side, and any required number of openings in the top plate to receive cooking utensils, or dampers to direct and regulate the heat.

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62. For *Portable Ovens, or Cooking Stoves*; Charles Vale, Newark, Essex county, New Jersey, June 26.

There appears to be but little novelty about this stove, excepting in the name given to it at the end of the claim, which is as follows: "The parts I claim as my invention, and not known, in the above portable ovens, are the particular construction of the fireplace, which only allows one-third of the fuel it will contain to be ignited at one time, and cause that to be regular as long as there is that quantity in it. The double shelves, and the manner of conducting the smoke and heat over the whole surface of them, by which so much fuel is saved, and from which I call it the *Chaloric Extractor*."

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63. For a *Machine for Cutting Straw*; James M'Math, Mead-town, Crawford county, Pennsylvania, June 26.

"What I claim as my invention, and not previously known in the above described machine is the so affixing the knives to the gate, or slide, that they will follow each other at a distance just sufficient to allow the first to have passed through, or nearly through, the material to be cut, before this second comes in contact with it, and so on according to the number of knives used; and by giving a degree of length to the gate, or slide, and also of length to the lever, by one stroke of the lever the whole number of knives shall each in succession have passed through the straw."

It is calculated that by such a machine, four times the work may be performed, "with little, if any, additional power."

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64. For a machine for *Felling Trees*; James Hamilton, city of New York, June 26.

The patentee, after describing the construction of his machine, says, "this applicant in the next place describes the principle of his invention, as follows. It consists of the combination of a horizontal saw with a crank movement, the saw being of any convenient length, but in the shape of a small segment of a circle, and the length of the crank with which it is directly connected being sufficient for the length of the intended stroke of the saw, the saw being fixed in a frame, and this moving in a centre fixed in another movable frame which is connected with and movable upon the same centre as that of the crank; this frame having a horizontal circular movement upon a roller, by force of a weight acting over a pulley, so as to bear the saw forcibly against the material to be sawed, the crank being made to act by any convenient mechanical motion, the whole operating so as to saw horizontally, it being designed for felling trees by sawing through the trunk of a tree horizontally, and near the ground."

Mechanical saws of this description have their uses, as for cutting off piles under water, &c., but they will never enter into competition with the axe of

the American woodman; and we are well convinced that in an attempt to use them in this way, his aid would not unfrequently be required to extricate the saw from the kerf in which it would become pinched.

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65. For a *Corn Shelling machine*; John C. Dunbar, Temple, Kennebec county, and Addison Powers, Carthage, Oxford county, Maine, June 26.

This is the most old fashioned, because it is the first fashion, of shelling machines, but the patentees propose to make the concave of three separate pieces of sheet-iron, and to perforate them like a grate.

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66. For a *Cooking Stove*; Thomas D. Burrell, Geneva, Ontario county, New York, June 26.

In the description of this Cooking Stove there are several things mentioned which are omitted in the drawing; such, for example, as openings for kettles, doors, &c. &c. The lower part of the stove, which is to contain the fuel, is represented in the form of a very low Franklin. The two upper plates of this, making part of the flues, extend far back, and from them two other plates run vertically to the height of two feet, forming a semicylindrical flue, eighteen inches in diameter within. The upper end of this also is double, and from it rises the smoke pipe.

A semicircular tin reflector is to be placed against this semicircular recess, and converts it into an oven, eighteen inches in diameter, and two feet in height. A vertical shaft within this, furnished with open, horizontal shelves, called a revolving reel, is to sustain the articles to be baked.

The claim is to "the oven formed by the flattened upright flue and covering; the upright revolving reel, and the combination of the door and openings in front, for the uses set forth." Which latter part, with its combination, we are left to guess at, it being entirely omitted in the drawing.

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67. For a *Napping Machine*; Reuben Daniels, Woodstock, Windsor county, Vermont, June 26.

This machine is intended for the narrow kinds of cloth. The napping cylinder is made about nine inches and a quarter in diameter, and about three feet in length. The surface consists of twenty-six lags, or strips, allowing a space between each for needles to pass in and out. The napping cylinder is hollow, and has a cylindrical shaft through its centre, upon which is fitted the necessary apparatus for projecting or retracting the needle points. This apparatus is governed by screws at the end of the cylinders. The needles are fixed on metallic plates very near together, so as to stand like the teeth of a comb. This cylinder may be so placed as to operate like the ordinary teasing machine, but its motion must be much slower.

What is claimed "is the principle, or improvement of varying, gauging, or graduating, the projection of the needles, wires or teeth, which are designed to do the work, performed by teazles in the common teasing machine."

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68. For a *Rotary Steam Engine*; Orson Baines, Van Buren, Onondaga county, New York, June 26.

This is another machine to blow away steam to little good purpose. A hollow gudgeon is to carry steam into a hollow revolving drum from two points on the edge of which it is to escape.

"Now what I claim as my own invention and not previously known, in

the above described machine, is the discharging of the steam on the outside of the rim of a tight enclosed circular wheel, at the greatest possible distance from the axis, or shaft, by which an increase of power is gained over any other rotary engine," &c. &c.

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69. For improvements in the *Loom for Figured Work*; E. Meily, jr. and J. & S. Mellinger, Lebanon, Lebanon county, Pennsylvania: first patented March 1st, 1834. Reissued under an amended specification, June 26.

The description and drawing of this machine under which the first patent was issued, were altogether defective, and although it has been intended to remedy these defects by the amended specification and drawing, the latter are so constantly, and necessarily, referred to in the former, as to render them inseparable. We think the improvements valuable for the purposes to which they are applied; but all that we can now do towards giving an idea of them is to insert the claim, however inadequate this may be.

"We claim as our invention the general arrangement of the parts connected with the round and oval wheels, as herein described, for the purpose of operating upon the needle shaft in the manner and for the purposes set forth. We claim this manner of carrying out the pattern cards by means of friction rollers, and the steadying the same by means of a loose roller in the doubling thereof. We also claim the mode described of preparing the pattern cards upon a block of wood, by means of a hollow punch and clearer, operated upon by a spring."

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70. For *Riding Saddles*; A. L. Van Horn, City of Philadelphia, June 26. (See Specification.)

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71. For a *Machine for Hulling Clover Seed*; John Whiteman, City of Philadelphia, June 26.

The seed to be hulled is put into a hopper which narrows down so as to leave a longitudinal opening through which the feeding is effected by means of a fluted revolving roller. The hulling is effected by means of revolving, metallic disks, or wheels, five or six inches in diameter, fluted, or grooved, at each side and on the edges. These are placed upon two shafts, standing in the same horizontal plane, the disks on one shaft standing between those on the other, and just clearing each other and the shaft, so as to admit the seeds to pass without being crushed. Any number of disks, of which the size of the machine admits, may be placed on each shaft. The disks revolve towards each other, and the feeding takes place in the centre between them. A comb-shaped board on each side prevents the seed from escaping outside of the disks.

The claim is to a machine so arranged and constructed as that a new hulling machine is thereby formed.

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72. For a *Rotary Steam Engine*; Charles Hill, Zanesville, Muskingum county, Ohio, June 26.

To understand the whole of the references made in the claim would require a drawing, and as our confidence in the Rotary Steam Engine is small, and our objections will yield to the omnipotence of success only, we wait the arrival of such a proof. This is one of the reaction engines, and the claim is to "the principle of increasing the surface of reaction, and diminishing the

motion, without diminishing the power of the steam; which is effected by the enlargement of the steam pipes, (as at D, D,) and the vacuum created by the condensation of the steam, giving a less velocity to the wheel, accompanied by a corresponding increase of power. I also claim as my invention the introduction of water and air, either separately or in connexion, for the purpose of creating the vacuum, and the manner of introducing and disposing of the same; together with the manner of disposing of the steam so as to assist in maintaining the vacuum. I claim as my invention the application of these principles, to attain the objects herein set forth, whether the same be effected in the precise manner described, or otherwise."

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73. For *Ever Pointed Pencil Cases*; Ellwood Mears, City of Philadelphia, June 26.

The improvement consists in the manner of forcing the lead out of the metal point, and is as follows. The slide, or band, which moves up and down the stick, is also capable of a circular motion around it. This slide, or band, has on its inner surface a screw thread, into which the nut of the pin, or wire, used in propelling the lead from the point, works. The band or slide is kept in its place, and pushes out this metallic point by means of two small screws fastened to the lead groove within the case, and rising on each end of the band. Thus by holding the case in one hand and turning the slide or band to the left, or, if preferred, by retaining the slide so as to be immovable, and turning the case to the right, the lead can easily and quickly be propelled from the metallic point.

"What I claim as my own invention, is the method of using the band, or slide in forcing the lead out of the metal point, instead of the complicated works heretofore in use."

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74. For a *Churn*; Isaac Wood, Connelville, Fayette county, Indiana, June 26.

There is an oval tub, through the sides of which a shaft is to pass, having a winch at one end by which it may be turned. The shaft must revolve in a water tight joint, and is to carry a number of arms or dashers, of such length as the tub will admit.

There is not any claim made, and, excepting in the shape of the tub, which does not offer any very apparent advantages, there is scarcely any difference between this churn and many others.

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75. For a *Mill for Grain, &c.*; William S. Johnson, City of New York, June 26.

The patentee calls this an "eccentric mill," and proposes it as proper for grinding paints, dye stuffs, snuff, and most other articles required to be ground. A sufficient description of it may be found at p. 34, Vol. 10, as patented by James Bogardus, of the City of New York, the difference between that and the one now before us being, most manifestly, colorable only. We should think it certain that if the claim of Mr. Bogardus was well founded, the present is an invasion of it.

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76. For a *Machine for Planting Corn*; Thomas D. Burrall, Geneva, Ontario County, New York, June 26.

After describing this seeding machine the patentee very truly says, "now in the above description there is perhaps no one part which is new in itself;"

and to this he adds: "But what I claim as my invention is the combination of the several parts above described, forming collectively a convenient and useful implement for furrowing, planting, covering, and rolling, at a single operation."

This sort of claim, to combination and arrangement, has become a kind of universal salvo where nothing new is to be found in the machine patented, but it will not answer; where there is real novelty in an invention, and it consists, as is most commonly the case, in combination and arrangement, it is as susceptible of being distinctly pointed out as novelty of any other sort: in the case before us, it is true, the task would have been a hard one.

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77. For an improvement in *Roofing Houses with Tin, Copper, and Zinc*; John Bouis, Baltimore, Maryland, June 26.

This improvement is very imperfectly described; the apparatus used for bending the edges of the plates is not well represented, nor is any thing particularly pointed out as forming the foundation of a claim. All that we can collect of any peculiarity is that "the grooves or edges of the groove roofing being made in a semicircular form, instead of an angle as formerly constructed, give the metal a better chance to expand or contract without the danger of cracking, and also form a gutter to carry off the water and dirt, without obstruction." There are no instructions given for fastening the roofing; we conclude, therefore, that there is not any thing new in this.

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78. For *Flasks for Moulding Iron Tea-kettles*; David Stewart, Danville, Columbia County, Pennsylvania, June 26. (See Specification.)

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#### SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a Patent for an improvement in Riding Saddles. Granted to A. L. VAN HORN, City of Philadelphia, June 26th, 1835.*

To all whom it may concern, be it known, that I, A. L. Van Horn, of the City of Philadelphia, have invented an improvement in the manner of making Riding Saddles of all descriptions, and that the following is a full and exact description thereof.

The saddle need not in its general construction be in any way altered from that now pursued by the manufacturers of that article. The saddle tree, the irons, the mode of covering, and in fact all the parts may be the same with those now employed by different workmen, my improvements consisting solely in the substituting webbing, or girth, of the kind denominated India Rubber Webbing, for that which is usually strained upon the saddle tree, and which forms the foundation for the seat. The India Rubber Webbing is a well known article, consisting in part of that substance interwoven with the ordinary materials of webbing, and communicating to it great elasticity, and that in a degree peculiarly adapting it to the new purpose to which I have applied it. In order to derive all the advantage possible from the use of this webbing, I take care in straining it to draw it as high upon the cantle as possible, as by this means it will have sufficient play without descending so low as to come in contact with the back of the horse, or with the saddle tree.

A. L. VAN HORN.

*Specification of a Patent for an Improvement in Flasks for Moulding Iron Tea Kettles, and other vessels of a similar nature. Granted to DAVID STEWART, Danville, Columbia County, Pennsylvania, June 26th, 1835.*

To all whom it may concern, be it known, that I, David Stewart, of Danville, in the County of Columbia, and State of Pennsylvania, have invented an improved mode of constructing Flasks for the moulding of Cast Iron Tea Kettles, by which the number of parts of which they ordinarily consist is reduced from four to two, and the necessity of turning the flask over in the operation of moulding is altogether obviated, and I do hereby declare that the following is a full and exact description thereof.

I use a mould board of cast iron, upon which the pattern and flask are to be placed. The mould board has a circular excavation, or gutter, around its centre, which is to be filled with casting sand, upon which that part of the pattern rests which forms the rim, of the opening in the top of the kettle, which part would otherwise be chilled by the mould board in casting. The pattern for the kettle is in the usual form, and has a square shank rising from the centre of that part which forms the opening for the lid, which shank fits into a square hole in the centre of the iron mould board, when the pattern is placed upon it for moulding.

The flask consists of two parts only, dividing horizontally immediately opposite the swell of the kettle, and the upper part extending a sufficient height above the bottom of the kettle for the requisite thickness of sand. The pattern being put into its proper place is surrounded by the lower half of the flask, and this is filled with the sand to a level; the upper half of the flask is then placed on, and the moulding of the outside completed, when the upper flask may be taken off, and the pattern removed. The manner of moulding the spout does not differ from that ordinarily pursued.

The mould for making the core, and the manner of filling it differs from that heretofore followed, the core mould being filled from the part which forms the bottom, instead of that which forms the top of the kettle. A mould board is prepared having a hole in its centre of the same size with that in the iron mould board, and into this the shank of the anchor, which is to sustain the core, is placed, and that half of the mould which corresponds with the top of the kettle is passed over it, and secured in its place. The other half of the core mould is then put on, and the whole is filled with sand, properly rammed in. In order to fill it, the core mould has a suitable opening, or openings in the part which is uppermost, and which corresponds with the bottom of the kettle, and when this is properly filled, and the core pierced for air holes, it is ready to be removed to the iron mould board, and anchored in its proper place.

What I claim as my invention, and wish to secure by letters patent, is the particular manner of constructing the flasks as described, in two parts only, for the moulding of tea kettles, and other articles of a similar form; the employment of the iron mould board; and the formation of the core in a separate box, or pattern, charged with sand at the bottom, and adapted in the way described to the anchor, which is to be placed on the mould board without the necessity of inverting, or being obliged in any way to raise or remove the same, in the operation of moulding. I also claim the application of the same principles of moulding to all kinds of hollow ware, which is swelled, or bellied, in the manner of tea kettles, varying the procedure in such a way as will be evident to every competent workman, so as to adapt it to the particular kind of vessel intended to be cast.

DAVID STEWART.

*Specification of a Patent for an improved machine for the purpose of Cutting Sausage Meat, and of Stuffing Sausages. Granted to ABRAHAM KEAGY, of Bradford County, and JOHN KEAGY, of Franklin County, Pennsylvania, June 15th, 1835.*

The cutting is effected by means of a cylinder, around which are placed knives which we usually make of a triangular form, one of the sides being in contact with the cylinder. This revolves within a concave, or hollow cylinder, furnished with similar knives so placed as not to interfere with those on the cylinder. These knives are but placed somewhat obliquely, so as to stand in the direction of a spiral around the cylinders. The revolving cylinder has its axis placed horizontally in a box, the sides and ends of which are enclosed excepting where the meat is admitted and discharged. A gudgeon projects through the box at one end to receive a crank or wheel to turn the cylinder.

The opening for feeding is on the upper side, and at one end of this box; and this opening is surmounted by a vertical trunk, which may be in the form of a parallelogram, of the width of the lower box, and about half its depth, more or less. A piston, or follower, is adapted to this feeding trunk, or hopper, from the middle of which a rod rises, operating as a piston rod, being acted upon by a lever, worked like a pump handle. The piston rod passes through the lever, and has a rack, or notches, upon it, which engage with the lever in its descent, but allow it to rise without raising the piston, so that the meat put into the feeding trunk is forced down by each successive stroke. To facilitate the passage of the meat into the horizontal, from the vertical trunk, I form a spiral excavation in the hollow cylinder, immediately under the vertical trunk; which operates as an inclined plane in producing the desired effect. The cut meat, when it arrives at the extreme end of the cutting cylinder passes out through an opening in the bottom of the box. When the feeding trunk is to be replenished, the lever may be turned back on its joint, and the piston removed, leaving the opening perfectly free.

When the cutting has been completed, the vertical trunk, with its piston, is used for the purpose of stuffing. To effect this, a shutter, or slider, is slipped into its place where it forms a bottom to the vertical, and cuts off its communication with the horizontal, trunk, and a tin, or other tube, of proper size, is fitted into an opening prepared for it on one side of the trunk, at its lower end, upon this tube the entrail to be stuffed is gathered, in the usual way.

To allow the escape of air, this latter tube has a small tube, or opening, soldered on its outside, from end to end. This opening may be semicircular, so as to make but a slight projection on the stuffing tube. The effect of this will be obvious.

We have not thought it requisite to give the dimensions of the respective parts, as they will vary according to convenience, and will depend upon the power to be applied, and the quantity to be cut. One thing, however is essential, namely, that the length and size of the cylinders, and the number of knives, be proportioned to the quantity to be cut; but this can be regulated also by the pressure made upon the piston.

We do not claim as our invention, the individual parts of the above described apparatus, but what we do claim is the general combination and arrangement of the respective parts, as herein set forth, for producing the required effect. Not intending, however, to confine ourselves to the exact form given, but to vary the same in any way, whilst the same results are produced by analogous means.

ABRAHAM KEAGY,  
JOHN KEAGY.

*Specification of a Patent for Washing Clothes, and for Churning. Granted to CHARLES OTIS, of Finksburg, in the County of Baltimore, and State of Maryland, June 15th, 1835.*

I make a revolving cylinder, or barrel, which is to turn upon gudgeons in the usual way, and having an opening through which the articles to be acted upon may be introduced, and secured by a close fitting door, or shutter. I cause this barrel, or cylinder, to revolve in a trough which serves to catch any suds that may be allowed to escape, and which, in the churning of butter may be filled with water, either warm or cold, according to the season of the year, and thus facilitate the operation. The parts thus far described I do not claim as constituting any part of my invention, the same having been repeatedly constructed by others; but what I do claim is the following appendage within the revolving cylinders. I place flat wings, or buckets, on the inside of the periphery of the cylinder, extending along from end to end; of these there may be two, three, or more, made of flat boards, the planes of which stand in the direction of radii to the cylinder. These boards may vary in width from two to six inches, more or less, according to the size of the machine, and I sometimes perforate them with holes, to increase the agitation of the fluid. They also serve to lift the clothes and suds in washing, or the cream in churning, more effectually than the pins which have sometimes been employed for that purpose. I confine my claim exclusively to the employment of the wings, or buckets, herein described. C. OTIS.

### **Progress of Theoretical and Practical Mechanics.**

*Report on the use of the Hot Air Blast in iron Furnaces and Foundries.*

*By A. GUENYVEAU, Engineer and Professor in the Royal School of Mines.\**

(Translated for this Journal, by Professor A. D. Bache.†)

This report embraces the observations made during a tour of examination of the furnaces and foundries in the south of France, in some of which the hot air blast is used. The tour was undertaken by order of the director-general of bridges and roads, and of mines.

In remarks upon the subject, a distinction must be made between the furnaces where coal is used and those which use charcoal. The amount of air required is so different in the two classes, being sometimes as two or three to one, that the apparatus for heating it is usually different. The results are, however, nearly the same for both classes. All the furnaces examined use ores from the same part of France. The hot air blast has succeeded best in the furnaces of Vienne (Isere), the two at Terre-Noire (near St. Etienne), and those of the Voulte (Ardeche.)

In one furnace, that of Firmy (Aveyron), the results with this blast were not satisfactory, either with raw coal or with coke. The large establishments of Creusot and Alais, and those of l'Orme (Loire), have not yet applied heated air. The fuel used in them is coke. At the furnace near Torteron, where the fuel is a mixture of charcoal and coke, the hot air blast has been used to advantage, in regard to the quality of the iron. In the various smelting furnaces in Burgundy and Franche-Comté, where charcoal is used as a fuel, the new process has proved satisfactory.

\* Annales des Mines, vol. vii. Livraison 1.

† This is a translation of extracts from the report of M. Guenyveau, and in parts where the details do not seem to be of special interest, an abstract of his results.

## I. HEATING APPARATUS.

Of these there are various forms in use. The objects sought are economy in heating the air, a sufficiently high temperature, and the preservation of the pipes. The apparatus used at Calder\* (Scotland) appears to answer the best purpose. It is in use at Vienne, and in one of the Firmy furnaces. The first apparatus put up was like that used at the Clyde† furnaces; this is still used at Torteron and la Voulte, but has, at Vienne, given place to the Calder apparatus. The heating pipes are two inches in diameter, and at Firmy have been replaced by others two and a half inches in diameter. It might seem that these pipes are too small, but experience has sanctioned their use. It is not known how long this apparatus will last; in fact the duration must depend upon the temperature to which the pipes are heated, and upon the nature of the coal. It is believed that the arrangement with highly inclined tubes will outlast that with horizontal ones. The temperature of the air is easily raised above the melting point of lead (604° Fahr.) The cost of the apparatus for each tuyere is about 1200 francs (\$240.)

The flame which appears at the trunnel head of smelting furnaces which use coke, has not been applied to heat the blast, although it has been advantageously applied in charcoal furnaces. It would seem that this mode of heating should apply particularly to furnaces in which raw coal is used, on account of the amount of unconsumed combustible matter which issues from the trunnel head; notwithstanding which, M. Dufrenoy gives one case, in the neighbourhood of Birmingham,‡ in which the heating apparatus placed upon the platform of the furnace did not answer the purpose. The temperature of the air could not be raised above 360° Fahr., and subsequently it was heated by a separate furnace which consumed four tons of coal for each ton of iron. As, however, the temperature to which the air is heated at the Voulte furnace is below that just stated, the question cannot be considered as decided.

The air blast is generally heated above melting point of tin (442° Fahr.), and sometimes above that of lead (604° Fahr.), and even higher. In other furnaces, as at the Voulte and Torteron, where horizontal heating pipes are used, the temperature has been diminished, in order to save the wear of the pipes. At the first mentioned furnace it never exceeds 340° Fahr., being at a mean about 320°, and at the second never exceeds the melting point of tin. At the furnaces of Terre-Noire the heat is carried by Taylor's§ apparatus to 572° Fahr. It has been said that the advantages of the hot air blast increase in the ratio of the temperature of the blast, an assertion which, although it appears probable, and has been confirmed by certain observations, is not true in all cases. At the Voulte the results were sensibly the same where the air was heated to 428° and to 320°.||

Several methods have been used to determine the temperature of the hot air blast. One was to use a common thermometer, with a metal scale; the bulb being inserted into the blast pipe near the nozzle. Another method was to use a slip of lead, tin, or of some fusible alloy, according to the tem-

\* See this Journal, vol. xv. p. 213, pl. 2, figs. 6, 7, 8 and 9.

† Ibid. vol. xv. p. 209, pl. 2, figs. 1 and 2.

‡ See this Journal, vol. xv. p. 272, pl. 3, figs. 15 and 16.

§ Similar to that described by M. Dufrenoy, vol. xv. p. 213.

|| It may readily be understood why an increase of 100° from 320° to 420° should not produce so sensible an effect as from 220° to 320°, or as from 120° to 220°.—

perature, which was exposed to the air issuing from a hole in the blast pipe.\* At Tarteron the alloy was two-thirds tin to one-third of lead.

Great inconvenience has been felt from the leakage of the pipes used in the heating apparatus. These leaks when they occur in the heating ovens are only discovered by a deficiency in the yield of the furnace. They occur commonly at the joints, and the liability to them increases with the increased temperature of the blast. The repairs which are necessary alter the supply of air, and thus derange the system of working.

It is a desideratum to render the leakage less common and the means of repair more easy. When these leaks occur, if the fire is not immediately extinguished, the pipes being no longer kept cool by the air passing through them, burn out very quickly. The heating apparatus placed near the trunnel head is free from this defect.†

The effect of these difficulties has merely been to produce a resort to the reduction of temperature noticed at the furnaces of La Voulte and Tarteron. The remarks of M. Dufrenoy on the forms of apparatus, confirmed as they are by extensive observation, deserve great attention.

The effects of heating the air upon the quantity and pressure of that passed into the furnace may be thus estimated. If we suppose the air heated from 60° to 568° Fahr. its bulk will be doubled and consequently, under the same pressure, but half the quantity will pass through a given orifice, which would have passed had the air not been heated. Generally, until the area or nozzle of the blast pipe is nearly doubled, the advantage of the hot air blast is not realized. Before this change in the nozzle, the furnace is not duly supplied with air. Besides, the pressure at the tuyere has been observed to diminish with a given pressure at the blowing machine, a fact which may be explained by the resistance of the air moving through the pipes of the heating apparatus, the elbows in which tend to make the resistance quite considerable in amount.

If then the pressure and the quantity of air thrown into the furnace should be the same with the hot and cold blast, the power of the blowing machine must be increased. This has not been found necessary in the English works, where on the contrary they have supplied more furnaces with heated air by the same blowing machine, than could be supplied with cold air. Less fuel being consumed in a given time, with a greater yield of metal, less air is required to support the combustion. In these works the power required to supply heated air is estimated at one-tenth more than that employed for the cold blast, for the same weight of ore, but as the weight of the air thrown in is diminished one-fourth, the same blowing machine which supplied three furnaces with cold air will supply four with the hot blast.

At the Calder furnaces (Scotland,) the pressure of the hot air blast was less than that of the cold air previously used by two-thirteenths, and at the Clyde works by one-sixth. M. Varin estimates the economy from this source at la Voulte works at one-fifth, the pressure being reduced from three inches and a quarter of mercury to two inches and a half.

At the Tarteron furnace where the heated air blast has neither changed sensibly the amount of fuel used, nor of iron produced, the blowing machine requires a little more fuel to produce the steam required to move it, than it did when cold air was used. At Wasseraalengen where the consumption of charcoal has not varied materially by the change from the cold to the

\* By reference to this Journal, p. 74, vol. xvi. a more convenient method of using the thermometer will be found.—TRANSLATOR.

† If so, it would seem that it must be deficient in heating power.—TRANSLATOR.

hot air blast, they require more power with the latter, a larger quantity of air being necessary in running the furnace. It is not said that the dimensions of the blast pipe nozzle have been changed. At Ancy-le-Franc in August, 1834, the pressure at the governor remaining constant, that at the tuyere was observed to fall to one-half, when the air was heated. The size of the nozzle was increased, but there was not an adequate power to supply the air required, and the yield of the furnace diminished.

Tuyeres, cooled by water, have been substituted for the ordinary ones in furnaces using the heated air blast; the cooling effect of the blast being taken away, the ordinary tuyere is rapidly burned out. Cast-iron water tuyeres have been found to last longer than those of wrought iron; they wear out in from three to six months.

In many establishments the blast pipe nozzle is permanently attached to the tuyere, an arrangement which answers well when it is not necessary to clean out the tuyeres. When this is necessary, the common arrangement is to be preferred, and this is generally the case in the French works even where charcoal is used.

When the nozzle is not closely fitted to the tuyere, the blast is slightly cooled before it gets into the furnace, and part of it does not pass in.

## II. ON THE EFFECTS AND ADVANTAGES OF THE HOT AIR BLAST.

The effect appears to be to increase the heat within the furnace, so that a refractory ore is fused; any stoppage in the furnace is prevented, and the working is more readily resumed after the furnace has been cooled. Less fusible ores may be used, less flux is required for their reduction, the slags are more fusible, and become spongy if water is thrown upon them when incandescent. This property has been observed only in the Styrian furnaces and others where charcoal is used as a fuel, and the ore is a manganese carbonate of iron. Further, grey pig iron is obtained with every kind of ore, this variety of iron requiring a high temperature for its production. Generally the heated air and combustible gases which issue from the trunnel head, are diminished in quantity and the heat is more concentrated in the lower parts of the furnace; a source of great advantage, but which causes a more rapid destruction of the hearth and boshes.

The working of the furnace when heated air is used is comparatively easy, there are fewer cases of clogging and they are readily remedied; the tuyeres are almost always free, no slag collecting and hardening about them. Frequently, a clogging in the furnace may be removed by raising the temperature of the blast. The advantages may be succinctly enumerated as follows.

1. A change in the iron which becomes more grey, and even black, and the slag is more fluid than when cold air is used.

2. An increase in the quantity of ore which a given weight of fuel will bear, whence results a diminution in the quantity of fuel required to produce a ton of metal, after the fuel required to heat the air has been taken into account.

3. A diminution in the quantity of flux, to which there are, however, exceptions.

4. An increase in the daily yield of a furnace.

We do not enumerate among the advantages that of using crude coal, because it has been ascertained both in Wales and at Decazeville, that this may be done with the cold air blast.

In regard to the quality of the iron produced by the hot air blast, the following facts have been collected.

It has been asserted that iron, thus obtained, requires to be remelted when it becomes duly tenacious, and yet the Lyonese founders complain that the iron of Vienne is weak. On the other hand, iron from the Torton furnace was cast into shells which required more powder to burst them than similar ones made from iron procured by the cold blast, the strength having been nearly double, in the former case, of that in the latter.

In England there appears to have been no sensible difference between the castings made from iron obtained by the two different methods.

The same uncertainty prevails in regard to the forged iron obtained from pigs reduced by the aid of the hot air blast. M. Dufrenoy and M. Debilly, consider the notions prevalent on this subject in England, to be founded in prejudice. My observations in the South of France have shown that there is, if any, a very slight difference in the quality of the iron in favour of that made by the cold blast. At one of the furnaces it was suggested that silicious ores gave a worse iron by this process than by the cold air blast, the great heat facilitating the union of the silicium with the carbon and iron. A careful analysis is required to demonstrate this theory, in favour of the probability of which it may be stated that at Firmy, where a very silicious ore is used, the iron made by the hot air blast is worse than that by the other process, and when refined, produces a worse malleable iron. It is remarkable, moreover, that the best iron is obtained when the ore is in excess in charging the furnace, in which case the iron is reduced at the lowest temperature.

[TO BE CONTINUED IN OUR NEXT.]

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### *Composition and specific gravity of different kinds of Glass.*

Ordinary flint-glass, according to Mr. Faraday's analysis, consists, in 100 parts, of silica 51.93, oxide of lead 33.28, potash 13.77, with minute portions of other substances. A specimen of the same kind of glass, manufactured for telescopes by the late M. Guinand, yielded the same chemist, silica 44.3, oxide of lead 43.05, and potash 11.75. Mr. Faraday found the specific gravity of M. Guinand's glass to be about 3.616, that of ordinary flint-glass 3.290, that of plate-glass 2.5257, and that of crown glass 2.5448.

Glass has usually been considered, without much actual inquiry into the subject, to be strictly a chemical combination of its ingredients, and in all respects a very perfect artificial compound. This, however, is far from being the truth, as will appear from the following facts. That the alkali in common glass of all kinds is in a very imperfect state of combination, many circumstances concur to evince. For example, Mr. Griffiths has shown, that if a small quantity either of flint-glass, or of plate-glass, be very finely pulverized in an agate mortar, then placed upon a piece of turmeric paper and moistened with a drop of pure water, strong indications of free alkali will be obtained; and that if the pulverization be very perfect, the alkali can be detected in other kinds of glass, containing far smaller quantities of it. This proves, that in whatever state of combination the alkali may be, it is still subject to the action of moisture. That flint-glass is by no means a compound resulting from very strong chemical affinities, and that the oxide of lead which it contains is as imperfectly combined as the alkali, has been shown experimentally by Mr. Faraday, and also appears from the tarnish which is produced on its surface by exposure to sulphuretted vapours, owing to the combination of sulphur with the lead. Glass which has long been exposed to the weather, frequently exhibits a beautiful iridescent appearance, and is so far decayed, that it may be

scratched with the nail. The glass of some bottles of wine which had lain in a wet cellar near the Bank of London upwards of 150 years, examined by Mr. Brande, was soft, and greatly corroded upon the surface, in consequence of the partial abstraction of its alkali. After reciting some of these facts, and others of a similar description, Mr. Faraday observes, "Glass may be considered rather as a solution of different substances one in another, than as a strong chemical compound; and it owes its power of resisting [chemical] agents generally, to its perfectly compact state, and the existence of an insoluble and unchangeable film of silica, or highly silicated matter, upon its surface." See Mr. Faraday's Bakerian Lecture on the manufacture of glass for optical purposes; *Phil. Trans.* 1830, pp. 46—50.—*Parke's Chem. Cat.*, by Brayley. (*Arcana*, &c. 1835.)

### Carriage Wheels.

On the 27th of May, at the Institution of Civil Engineers, Mr. Walker's paper, on the subject of the most advantageous form for wheels of different kinds of carriages, having been read, a member remarked that there were some practical objections to the use of horizontal axles, which were not alluded to in Mr. Walker's communication—one, the difficulty of making the wheel perfectly secure from coming off the axle, as a greater strain is unavoidably thrown on the linchpin. The wheels of ordinary country wagons are usually much dished, and the axles slightly inclined downwards, by which arrangement, the principal strain is thrown on the shoulder of the axletree, and a very ordinary description of linchpin will answer the purpose. As far as regards friction, and, consequently, an easy draught for the horse, the straight axle and cylindrical wheel have the preference; but, for safety, strength, and durability, he thought the inclined axle and dished wheel superior; besides which, there exists much practical difficulty in constructing carriages with horizontal axles and cylindrical wheels. It was remarked, that one reason for the conical wheel being so much adhered to in practice, was the greater liability of the tire on the cylindrical wheel to get loose; by the constant rolling of a heavy weight frequently on a small extent of surface, the tire becomes slightly elongated, and, on a cylindrical wheel, gets loose, and may occasion accidents; the conical wheel provides against this, by its greater elasticity, and the tendency it has to become more flat in the dishing, and, in a slight degree, to stretch out the periphery. It was stated that, at first, the cylindrical shape was adopted in Jones' patent iron wheels; but it was found that, with upright wheels, the width of track was required to be seven feet, and some of the streets do not admit of such a vehicle passing; also, in crowded thoroughfares, the nave is exposed, and liable to come in contact with other carriages.—It was stated, that a wheel of a new construction had lately been attempted, and was likely to become an improvement; the rim and nave are of cast-iron, and the spokes of wrought-iron; a wooden band is put round the cast-iron rim, which again is surrounded and fastened on by a wrought-iron tire, secured in the ordinary manner.—It was mentioned that, in Austria, cylindrical wheels are invariably used for wagons and heavy carriages, but for light vehicles the dished wheel is generally preferred.—A member stated, that in the neighbourhood of Edinburgh, the common stone carts belonging to the Cragleith, and other quarries, are generally made with broad cylindrical wheels.

On June 3, the conversation on the subject of the best form for wheels of carriages was resumed. An ingenious method was adopted by Messrs.

Jones, to exhibit the friction occasioned by conical wheels: a carriage was run upon the edges of loose boards, placed side by side; it was shown that, while the board under the middle part of the wheel remained stationary, that at the outside was pushed forward, and the board on the inside, backward; such, however, can only occur when the whole breadth of the wheel touches the ground, which is seldom the case, a wheel of nine inches having frequently a bearing of only three inches, in consequence of the middle tire being made of larger diameter.—*Arcana*, &c., 1835.

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*Rutter's Heat Process.*

Dr. Daubeny brought before the meeting the economical employment of coal-tar in connexion with water as fuel, according to the method lately suggested by Mr. Rutter.\* A discussion then arose as to whether the water in this case acts chemically or mechanically, or both, in facilitating the combustion of the tar. Mr. Macintosh stated, that by repeated experiments he had found, that coal-tar gave no more heat when burned than an equal weight of *splint* coal, the kind preferred, where a long continued heat is required. Mr. Low also stated, that from long experience he could affirm, that the use of water along with coal-tar was productive of no benefit whatever, and that 3 gallons, or 33 lbs. of coal-tar, give an equal amount of heating effect, fully, to 40 lbs. of coke, made from the Newcastle coal of the Hutton seam. From the discussion on this subject, which was protracted for some time, it appears to be established, 1. That tar may be used as fuel, but that it does not give much more heat than the same weight of the best coal. 2. That when mixed with water, it flows more easily through tubes, but does not appear to evolve more heat than when used alone.—*Jameson's Journal*.

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**Progress of Physical Science.**

*On some elementary laws of Electricity*, by W. SNOW HARRIS, Esq. F. R. S. &c.

Mr. Harris has opened some new views of Electricity by decidedly original experiments; he concludes that many of the phenomena treated in the course of his paper do not seem to have been contemplated in the more perfect theories of Electricity.

The new instruments invented by Mr. Harris to render research more easy and results certain and measurable are 1. A new electrometer by divergence. 2. An electrometer measuring directly the attractive force of an electrified body in terms of a known standard of weight, estimated in degrees upon a graduated arc. 3. A unit of measure for electrical charges, furnished by a small jar with an attached discharging electrometer. 4. A balance electrometer. By the aid of these instruments, or of a combination of them with other general means of experiment, and with the electro-thermometer previously invented, the following laws have been established.

1. When the amount of surface of an electrical conductor is varied, or the quantity of electricity distributed upon a given surface, the figure of the surface being the same, the force of attraction for other bodies varies inversely as the square of the relative superficies.

Thus a given quantity of electricity being divided between two conductors

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\* Originally suggested by Capt. Morey, of New Hampshire.

of equal surface, each one exerts an attractive force of only fourth that which is exerted when the same quantity is distributed upon a single conductor.

This law Mr. Harris considers to be connected with the following facts. That the force of attraction exerted between the two bodies, one of which is electrified, is more or less diminished by the presence of a neutral, or other body, sharing the attraction. This leads him to distinguish three elements peculiar to the conditions of electrical accumulation. 1st. The comparative quantity actually accumulated. 2nd. The quantity not sensible to the electrometer. 3d. The quantity appreciable by the electrometer. The first he calls *quantity*; the second *controlled quantity* or *controlled action*; and the third *free quantity* or *free action*. Mr. Harris limits the term *electrical tension* to "the electric force of a given quantity accumulated in a given space." The term *intensity* is different from this being "applied to the indications of an electrometer and immediately referable to what [he] has called the free action," that is to the operation of either a part, or the whole of the total force in a given direction, up to the point of discharge." The "intensity" by the law above stated varies as the square of the density of the electrical stratum or as the square of the "tension." In connexion with this subject Mr. Harris examines Singer's theory that the diminished intensity observed in disposing a given quantity of electricity on an extended surface is referable to the attractive force of the atmosphere, to the influence of which the electric particles become more extensively exposed. This view he finds to be inconsistent with direct experiment as it is also with the law above stated.

2. The heating effects of the same quantity of electricity is the same, the number of jars, and length of circuit through which the discharge is made, being the same. A change in the tension of the electricity produces no change in heating effect. This fact had previously been shown by Faraday, in regard to the magnetic and chemical effects of electricity.

3. The distances of discharge between two electrified conductors varies directly as the quantity accumulated upon a given surface. The distance through which an electrical accumulation can discharge itself in air of a given density is an accurate measure of the comparative quantity in a unit of surface. The same law of relation holds when the surfaces are varied, thus the distance of discharge is invariably as the discharging surface, for a given quantity of electricity. This third law is consistent with the first.

4. It follows from the third law that the resistance of the atmosphere to the passage of electricity, is the same for all distances, being produced simply by its pressure.

When the density of the air is diminished, the distance of discharge (striking distance) varies inversely as the density, the quantity of electricity accumulated on a given surface being the same. The quantities of electricity required to overcome a given striking distance vary directly as the density of the air. These conclusions accord with the first law.

The temperature of air has no effect on its conducting power for electricity otherwise than as it changes the density. If therefore heat be material it is a non-conductor of electricity, not impairing the insulating power of air which contains it.

5. The resistance of conductors to the passage of electricity is of a different kind from that of air and other non-conductors; it is, other things being the same, directly as the length of the circuit.

Heat impairs the conducting powers of conductors for electricity, as has been asserted by Davy and Professor Christie, but denied by Professor Ritchie.

6. The attractive force of plane conductors of a given area charged with a given quantity of electricity varies with the figure, being greater as the perimeter is greater. This force is therefore least when the area forms a circle and greatest when it is extended into an indefinite right line. The perimeters being the same the attractive forces (intensities) are inversely as the areas.

The electrical capacities of a sphere or cylinder (that is the quantity which they can receive with a given intensity,) are the same as of the plane figures into which it may be supposed to be rectified.

[TO BE CONTINUED IN OUR NEXT.]

## Mechanics' Register.

*List of American Patents which issued in October, 1835.*

	Oct.
589. <i>Double Speeder</i> .—William Field, North Providence, Rhode Island,	6
590. <i>Lampwicks, raising</i> .—Samuel Rust, New York,	6
591. <i>Pelisse Wadding</i> .—Stukley Turner, Cranston, Providence County, R. I.	6
592. <i>Planing Boards, &amp;c.</i> —Reid R. Throcmorton, New York,	6
593. <i>Fire Places</i> .—Ebenezer S. Greely, Dover, Penobscot, Maine,	6
594. <i>Clower Seed, &amp;c. cleaning</i> .—Moses Davenport, Philips, Somerset Co., Maine,	6
595. <i>Silk-worms, rearing</i> .—Gamaliel Gay, Poughkeepsie, New York,	6
596. <i>Saw Mill</i> .—Uri Emmons, New York.	6
597. <i>Thrashing &amp;c. Machine</i> .—Russel Bradley, Williston, Vermont,	6
598. <i>Spring Saddle</i> .—Joel Woodward, Marshalton, Pennsylvania,	6
599. <i>Slave and Shingle Machine</i> .—John Everhart, J. Pearson, J. Morford and N. Everhart, Wayne, Ohio,	6
600. <i>Alcohol from Apples</i> .—Anson Wolcott, East Bloomfield, New York,	6
601. <i>Ploughs</i> .—William Walker, Washingtonville, Pennsylvania,	6
602. <i>Caoulchouc, cutting</i> .—William Atkinson, New York,	6
603. <i>Ropes, laying</i> .—John Goulding, Boston, Massachusetts,	10
604. <i>Hemp, &amp;c. hatching</i> .—John Goulding, Boston, Massachusetts,	10
605. <i>Horse Power</i> .—Moses Davenport, Philips, Somerset County, Maine,	10
606. <i>Tin Baker</i> .—Nathaniel D. Whitin, New York,	10
607. <i>Cooking Stove</i> .—Elnathan Samson, St. Lawrence County, New York,	10
608. <i>Clower Seed, &amp;c. thrashing</i> .—Asa Burgess and Herman Baldwin, Litchfield County, Connecticut,	10
609. <i>Hydrostatics and Pneumatics</i> .—R. Mills H. B. Fernald, City of Washington,	10
610. <i>Washing Machine</i> .—John O. Geer, Norwich, Connecticut,	10
611. <i>Staves, cutting</i> .—George Pack, Sullivan, New York,	10
612. <i>Rail-roads</i> .—Roswell Bourne, Lancaster, Massachusetts,	10
613. <i>Churn</i> .—Asahel Bacon, Windsor, New York,	10
614. <i>Rotary Steam Engine</i> .—Arnold Buffum, Philadelphia, Pennsylvania,	10
615. <i>Doffer for Wool Cards</i> .—Stephen R. Parkhurst, Providence, Rhode Island,	10
616. <i>Grates or Grate Bars</i> .—Jordan L. Mott, New York,	14
617. <i>Roads, constructing</i> .—Thomas Earl, Burlington, New Jersey,	14
618. <i>Cast-iron Window sash</i> .—James S. Stoddard, Macedon, New York,	14
619. <i>Canal Boats</i> .—James O'Connor, Philadelphia,	14
620. <i>Springs of Carriages</i> .—Henry Pace, Senr. Cincinnati, Ohio,	14
621. <i>Lathe</i> .—James Haven, Newport, New Hampshire,	14
622. <i>Rail-road Car</i> .—George W. Cleaveland, Baltimore, Maryland,	14
623. <i>Stove, or Furnace</i> .—Denison Olmsted, New Haven, Connecticut.	14
624. <i>Gimblets and Augers</i> .—Orville B. Percival, East Haddam, Connecticut,	14
625. <i>Washing Machine</i> .—Henry Ault, Philadelphia, Tennessee,	14
626. <i>Fire Arms</i> .—Samuel Ladd, Waltham, Massachusetts,	14
627. <i>Felloes, cutting</i> .—J. S. Brown and J. T. Barker, Philips, Maine,	14
628. <i>Mill for Coffee, &amp;c.</i> —David Richmond, M <sup>c</sup> Arthurstown, Ohio,	14
629. <i>Felloes cutting</i> .—W. Braley and M. L. Worthley, Philips, Maine,	14
630. <i>Bridges</i> .—Richard T. L. Witty, Lowell, Massachusetts,	14

631. <i>Sparks, arresting.</i> —Hunt C. Wiatt, Weldon, North Carolina,	15
632. <i>Cooking Stove.</i> —Horatio B. Wade, Cincinnati, Ohio,	17
633. <i>Coal Stove, Anthracite.</i> —Eliphalet Nott, Schenectady, New York,	17
634. <i>Tanning, preparing Skins for.</i> —J. C. F. Saloman, Reading, Pennsylvania,	17
635. <i>Steam Boilers.</i> —J. C. F. Saloman, Philadelphia, Pennsylvania,	17
636. <i>Ploughs.</i> —Jarius S. Tefft, Amherst, New York,	17
637. <i>Washing Machine.</i> —Isaac Spicer, Norwich, Connecticut,	17
638. <i>Screw for Glass Knobs.</i> —Orrin Newton, Pittsburg, Pennsylvania,	17
639. <i>Cement for Cisterns, &amp;c.</i> —W. H. Carson and G. Roberts, York, New York,	17
640. <i>Biscuit, &amp;c. cutting.</i> —T. Havener and T. H. Havener, Washington City,	17
641. <i>Calendering Cloth.</i> —Zenas Bliss, Johnston, Rhode Island,	17
642. <i>Roofs, covering.</i> —Phineas Burgess, Brooklyn, New York,	17
643. <i>Crackers, &amp;c. cutting.</i> —William R. Nivens, New York,	17
644. <i>Feathers, cleaning.</i> —George Reynolds, East Hartford, Connecticut,	17
645. <i>Planing boards, &amp;c.</i> —Reid C. Throckmorton, New York,	22
646. <i>Bricks and Tile.</i> —Benton P. Coston, Sterling, Pennsylvania,	22
647. <i>Surveyor's Compass.</i> —Samuel R. Miller, Port Royal, Virginia,	22
648. <i>Tubes and Hinges.</i> —William Shaw, Buffalo, New York,	27
649. <i>Mortising Timber.</i> —John M'Cintic, Chambersburg, Pennsylvania,	27
650. <i>Cars, &amp;c. propelling.</i> —Alexander M'Grew, Cincinnati, Ohio,	27
651. <i>Sawing Stone.</i> —Daniel Bunnel, Xenia, Ohio,	27
652. <i>Sugar, &amp;c. boiling.</i> —John Steele, jr. New York,	27
653. <i>Stove.</i> —Philip Benedict, Lancaster, Pennsylvania,	27
654. <i>Oven.</i> —Jacob Baldwin, New York,	27
655. <i>Boots, &amp;c. cutting.</i> —Josiah T. Buck, New Canaan, Connecticut,	27
656. <i>Horse Collars.</i> —Caleb Angerine, New York,	27
657. <i>Moulds for Sugar, &amp;c.</i> —Charles Duncan, Williamsburg, New York,	27
658. <i>Power Motion Machine.</i> —David Russell, Tuscumbia, Alabama,	27
659. <i>Portable Saw Mill.</i> —David Russel, Tuscumbia, Alabama,	27
660. <i>Rail-road Carriage.</i> —William T. James, New York,	27
661. <i>Fire-place.</i> —John Chapin Howard, Howard's Valley, Connecticut,	27
662. <i>Cotton Whipper.</i> —Luccan Osgood, Pomfret, Connecticut,	27
663. <i>Cotton Seed, hulling.</i> —A. Miller and T. Lawes, Washington County, Miss.	27
664. <i>Plough Coulters, &amp;c.</i> —Samuel A. Sperry, Washtenaw, Michigan Territory,	28
665. <i>Lock for Drawers.</i> —Edward Brown, Lynchburg, Virginia,	28
666. <i>Cloths, drying.</i> —Stephen R. Parkhurst, Worcester, Massachusetts,	28
667. <i>Planing Machine.</i> —Ira McLaughlin and Hiram Hill, Sunderland, Vermont,	28
668. <i>Staves, dressing.</i> —Joseph Sweet, Lycoming County, Pennsylvania,	28
669. <i>Corn, crushing, &amp;c.</i> —Anderson P. H. Jerdon, Madisonville, Tennessee,	28
670. <i>Cement.</i> —Charles Clinton, Minnisink, New York,	28
671. <i>Horse Power.</i> —A. Trahern, H. Heberling, Wm. E. Lukins and J. Heberling Harrison County, Ohio,	28
672. <i>Ploughs.</i> —John W. Jordan, Lexington, Virginia,	28
673. <i>Gridiron, rotary.</i> —Kellog Strong, Meriden, Connecticut,	28
674. <i>Cutting Teeth, &amp;c.</i> —Andrew T. Mirven, Lycoming County, Pennsylvania,	28
675. <i>Pumps.</i> —Joseph Redelsperger, Mansfield, New Jersey,	28
676. <i>Rotary Pump.</i> —C. Peters and Benjn. Dean, Poughkeepsie, New York,	28
677. <i>Truss, spring.</i> —Henry Reid, Augusta, Georgia,	28
678. <i>Comb, metallic.</i> —Nathaniel Bushnell, Middletown, Connecticut,	28
679. <i>Taylor's Measure.</i> —Frederic A. Fairchild, Columbus, Georgia,	28
680. <i>Steel Yard.</i> —C. F. Dahl, Pittsburg, Pennsylvania,	28
681. <i>Stove, or Fire Place.</i> —Daniel Sutherland, Lisbon, Maine,	28

TO READERS.

Owing to the press of original matter for the present number of the Journal, it has been necessary to omit many selections prepared for the number. This has been done in those departments which are most copiously represented in the original matter.

The next number will contain a further portion of the report of the Committee on the explosions of Steam-boilers.

The *Mechanics' Register* will also be supplied with selections at present unavoidably excluded.

COM PUB.

CELESTIAL PHENOMENA, FOR FEBRUARY, 1836.\*  
Calculated by S. C. Walker.

Day.	H'r.	Min.				
3	7	4	N. App. $\gamma$ and 42 Leonis, ,6, $\gamma$	N.	1'6	V.
3	12	41	Im. i. Leonis, ,6,		47°	33°
3	14	4	Em.		247	280°
8	16	13	Im. $\beta$ Libræ, ,6,		70	53°
8	17	27	Em.		220	221°
28	6	27	Im. $\lambda$ Cancræ, ,6,		76	19°
28	7	52	Em.		268	219°

*Meteorological Observations for October, 1835.*

Moons.	Days.	Therm.	Barometer.	Wind.	Force.	Water fallen in rain.	State of the weather and Remarks.
		Sun rise.	Sun 2 P.M. rise.	Direction.		Inches.	
☉	1	39°	57°	W.	Brisk.		Lightly cloudy—flying clouds.
	2	38	53	SW.	do.		Lightly cloudy—flying clouds.
	3	43	54	W.	do.		Clear—flying clouds.
	4	43	62	SW.	Moderate.		Cloudy—flying clouds.
	5	53	69	SW.	do.		Cloudy—rain with high winds.
	6	63	58	SW. W.	do.	1.20	Rain—cloudy.
	7	49	55	W.	do.		Flying cloud—cloudy.
	8	39	54	W.	do.		Clear day.
	9	39	56	W. SW.	do.		Clear day.
	10	42	62	W. SW.	do.		Clear—hazy
	11	44	66	SW.	do.		Cloudy—hazy
	12	49	59	NE.	do.		Hazy—do.
	13	52	61	SW.	do.		Cloudy—clear.
☾	14	44	70	SW.	do.		Cloudy—lightly cloudy.
	15	56	64	SW.	do.		Hazy—do.
	16	56	70	SE.	do.		Cloudy—hazy.
	17	52	63	SE.	do.		Cloudy—do.
	18	61	74	E. NE	do.		Cloudy—do.
	19	63	75	SE.	do.		Cloudy—rain—flying clouds.
	20	63	75	S. SW.	do.		Cloudy—cloudy.
	21	63	76	SE.	do.		Cloudy—fog—lightly cloudy.
	22	60	70	SE.	do.		Fog—hazy.
	23	54	63	SE.	do.		Cloudy—lightly cloudy.
	24	47	60	SE.	do.		Fog—cloudy.
	25	38	52	NW.	do.		Cloudy—flying clouds.
	26	33	57	N.	do.		Clear—frost—clear.
	27	44	60	SE.	do.		Clear—frost—clear.
	28	44	62	SE.	do.		Clear—clear.
	29	45	65	W.	do.		Partially cloudy—clear.
	30	57	62	S.	Moderate.	.13	Fog—hazy.
	31	45	57	S. W.	do.	1.38	Heavy fog—rain.
	Mean	49.57	62.03				Cloudy—clear.
			29.95				
			29.93				
				Thermometer.			
				Maximum height during the month, 76. on 20th.			
				Minimum do. 33. on 26th.			
				Mean do. 56.22			
				Barometer.			
				30.25 on 25th.			
				29.16 on 12th.			
				29.94			

\* The Celestial Phenomena for 1836, include all the occultations of fixed stars by the Moon to the 6th magnitude inclusive visible at Philadelphia.

The angles under N. and V. respectively denote the angular distance of the point of immersion or emersion, from the *apparent* north or vertical point of the Moon's disc, as seen in a telescope which inverts. These angles are reckoned to the right or apparent west round the circle.

S. C. W.





**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
Of the State of Pennsylvania,  
AND  
**MECHANICS REGISTER;**

DEVOTED TO  
**Mechanical & Physical Science, the Arts & Manufactures,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

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FEBRUARY, 1836.

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**Practical and Theoretical Mechanics.**

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*Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.*

(Continued from page 20.)

IV. The next query may be thus stated: *when steam, surcharged with heat, is produced within a boiler by the contact with heated metal, does this steam remain surcharged, or does it take up water from contact with that in the boiler, and become saturated steam?* If the latter supposition be correct, at what pressure and temperature with regard to the temperature of the surcharged steam, and to that of the water on which it rests?

The answer to this question is given by the experiments just detailed; and as they established the negative in relation to the surcharged steam becoming saturated, there was no necessity for a repetition of the experiments to ascertain the precise temperature of the water in the boiler. When fire was applied to the top of the boiler, the water within was at  $318^{\circ}$  Fah.; a moderate fire was kept up below, and one so nearly uniform, that great variations from that temperature could not have taken place, and which the results satisfactorily show, did not occur. If we assume that during the experiments the temperature was  $308\frac{1}{2}^{\circ}$  Fah., a remarkable correspondence will be found in the observed pressures, and in those calculated on the supposition that this steam was expanded by heat, as a gas would have been, without any addition of water. The table below gives the temperatures of the surcharged steam observed at different times during the course of the experiments; the pressure shown by the gauge at that temperature; the pressure which would have been produced by heating steam at  $308\frac{1}{2}^{\circ}$  to the temperatures given in the first column by the mere effect of expansion; and the pressures of saturated steam at the different temperatures.

Temperatures of surcharged Steam.	Corresponding pressures from experiment.	Pressures calculated from expansion of Steam, $308\frac{1}{2}^{\circ}$ by heat.	Pressures of saturated Steam at the different temperatures.
308 $\frac{1}{2}$		5.2	
376	5.7	5.6	10.4*
462	5.8	6.2	31.6
506	6.1	6.5	48.0
526	6.6	6.7	57.3
533	6.8	6.75	61.1

A comparison of the second and third columns shows that in these experiments, which lasted more than two hours, the surcharged steam remained in contact with water without acquiring from it the water necessary to convert it into saturated steam, but retaining its surcharged state. There is nothing to warrant the belief that any of the surcharged steam was condensed by the water.

#### *V.—Inquiry in relation to Plates of Fusible Alloys.*

It is well known that one of the most scientific nations of Europe relies, particularly, as a means of safety for steam boilers, on the use of plates of fusible metal. The plates are alloys of tin and lead, or of these two metals with bismuth, the proportions of the component metals regulating the point at which they fuse. In France these alloys are prepared at the royal mint, where plates made from them, or ingots of the alloys may be purchased for use. The examinations which must have been made to determine the proportions of the metals necessary to produce an alloy fusing at a given temperature, and the circumstances of fusion, have not, as far as the committee know, been made public. A table of the fusing points of different alloys of tin, lead, and bismuth, &c., was drawn up by Parke, from experiment, and is contained in his chemical essays, vol. ii. page 615. This table was made the basis of the investigations† undertaken by the committee, but they soon found it convenient to depart, more or less, entirely from it.

The method employed by Parke for determining the fusing point of a metal, or rather the solidifying point of the melted metal, was ingenious. On melting a metal, and allowing it to slowly cool to the point of congelation, and observing a thermometer plunged in it, a rise of temperature, and then a stationary point, is observed; this is a point where a change is going on, by which the heat given out in the change is equal to that of which the metal is robbed by the surrounding medium. This point usually coincides with the passage of the metal to the solid state, from what may be either the liquid state, or a semi-fluid state, similar in aggregation to sand; sometimes the alloy is solid throughout, before the stationary point arrives; and sometimes there is more than one such point.

The stationary point is not that at which the alloy, when used as a fusible plate for a boiler, gives way; the plate being covered by a perforated brass disk, to prevent its being pressed outwards before fusion, and so reduced in

\* These numbers are obtained from the table of Arago and Dulong, by interpolating between the terms; and though not rigidly correct, are abundantly so for this purpose; the last two numbers are obtained, by substitution, in the formula given by these experimenters, as resulting from their observations.

† At the time these experiments were made, the paper of Rudberg *Ann. de Chimie. et de Phys.* Vol. 48, had not appeared.

thickness as to burst, the metal is not forced out through these openings until perfectly fluid; if any part of the metal becomes fluid before the rest, and gives way, the rest being in the sandy state, just spoken of, the particles seem to act like those of sand in a similar case, and to oppose an effective resistance to the pressure of the steam; these facts will be further developed in the examination of the application of these plates.

The stationary points, when taken with due reference to the state of the metal at the time, afford so many approximate marks by which to compare together the fusibilities of the plates, and to ascertain whether they bear a due relation to each other, when fused, in place upon the boiler; and to study the alloys themselves. In composing alloys of the metals, before referred to, the tin was fused first at as low a temperature as possible, then the bismuth and lead added, the heat being kept up; these metals were readily taken up by the liquid tin, and were thus little exposed to oxidation: the surface of the alloy was always protected by a stratum of oil. The metal was constantly stirred to promote the uniform diffusion of the different metals throughout each other.

The alloy being liquid, a thermometer, of which the errors had been carefully ascertained, was plunged into it, and the fall noted until it reached the lowest point; the rise to the stationary point followed, and at this the thermometer usually remained for such a length of time, often some minutes, as to render any error of observation unnecessary. Some of the alloys have no stationary point, properly so called, and the beats of a second's pendulum were used to determine the rate of their loss of heat. When the quantities of metal used were inconsiderable, the heat was observed to be carried off so rapidly as to lower, or entirely to destroy, the stationary point: to avoid this, the crucible containing the alloy, was placed in a second one, the edges of the former resting on the middle of the sides of the latter. The quantity of metal used was never less than between five and six ounces, troy.

The stationary point being at the passage of the liquid metal to the solid state, or at some interior change of the solid itself, the thermometer was entangled in the metal; and in moving the alloy, to remelt it, the instrument was endangered.\* This was remedied by the use of a small cylinder of very thin sheet iron, containing mercury. This cylinder was placed in the alloy, and filled up to the surface of the metal with mercury, and the thermometer could now be readily placed and removed. Care was taken to ascertain that the stationary point, given in the cylinder, was the same with that shown by the naked thermometer. As some of the alloys expanded considerably on congealing, it was supposed that the cylinder might prevent error from the compression of the bulb of the thermometer, but no such compression in the instrument used was detected by frequent trials.

As the alloys were intended for ordinary use, it was deemed advisable to ascertain how far the impurities of the metals, as they occur in commerce, would cause a variation in the fusing point. Tin has a very uniform purity in commerce, the grain or stream tin being always accessible. The bismuth of commerce being obtained principally from the native bismuth, is probably not very variable.† The lead contains variable quantities of silver, copper, and iron. The first experiments were made on the fusing point, on various specimens of common tin: this tin showed, by reagents, a trace of iron and of copper, as impurities. The fusing point of grain tin is  $442^{\circ}$  F.

\* Although the instrument was frequently used in determining the stationary points, no permanent changes in the indications of the instrument, such as was noticed by M. Rudberg, took place.

† It is proper to state, however, that some specimens were procured, obviously obtained from the sulphuret, and contaminated with it. They were not used.

COMMON TIN.	Stationary Point.	Remarks.
<i>Specimen, No. 1.</i>		
First experiment,	441.75°	Thermometer in cylinder.
Second, do.	442.25	do. do.
Third, do.	441.75	Without cylinder. Stirred.
Fourth, do.	442.00	do. do.
Mean,	441.94	
<i>Specimen, No. 2.</i>		
First experiment,	441.50	In cylinder.
Second, do.	442.00	do.
Mean,	441.75	
<i>Specimen, No. 3.</i>		
First experiment,	438	In cylinder.
Second, do.	439	do.
Mean,	438.5.	
<i>Specimen, No. 4.</i>		
First experiment,	441	Thermometer in cylinder.
Second, do.	443	do. do.
Third, do.	441½	Without cylinder. Stirred.
Fourth, do.	443	do. do.
Mean,	442.12	
<i>Specimen, No. 5.</i>		
Single experiment,	442	In cylinder.

The fusing points of the different specimens varied slightly, but the differences, in a practical point of view, are nothing.

The fusing points, in the case of tin, coincide nearly with the stationary points, the metal passing rapidly from the liquid to the solid state. When the change of state is rendered more rapid by agitation, the stationary point is slightly raised; the heat, which is produced in the change, not having time to be carried off, as when the change is allowed to proceed by degrees.

Lead from the Paris mint, of the kind used for cupellations, and containing a very minute quantity of silver, as an impurity, was next compared with the common lead used by plumbers. The experiments were as follows:

Pure Lead.	Stationary Point.	Common Lead.	Stationary Point.
First experiment,	601°	First experiment,	604°
Second, do.	601	Second, do.	604
Third, do.	602		
Fourth, do.	602		
Mean,	601.5	Mean,	604

An attempt was next made to ascertain what effect the impurities shown by the fusing point of lead would have upon the fusing points of alloys, into which it entered. Alloys, in atomic proportions were selected, as much was expected from them in the way of avoiding the slow passage from the liquid to the

solid state, which was observed to be the property of certain mixtures of the metals. Alloys of tin and lead were therefore made in atomic proportions; first, of grain tin and the lead already spoken of, from the Paris mint; the second, of block tin and common lead. The tin was employed in multiple proportions, as being the more fusible metal, it would probably enter more largely than the other, into the composition of fusible plates for steam-boilers. The equivalent of lead is 104; of tin, 58; the first alloy was composed of the two metals, united in this proportion, the total weight of the components being about ten ounces, troy; a new equivalent of tin was next added, and so on, through the series: the results are given in the following table.

Equivalents of		Stationary point.	Number of Observations of which the stationary point is the mean.	REMARKS.
Pure Lead.	Grain Tin.			
1	1	354 $\frac{1}{2}$	2	<p>Begins to lose fluidity at 430°, soft solid at 410°, do. 400°, still yields to a stick at 350<math>\frac{1}{2}</math>°, rises to 354<math>\frac{1}{2}</math>°, the stationary point, hard and unyielding.</p> <p>Thermometer fell to 356<math>\frac{1}{2}</math>°, metal still liquid, congeals very irregularly, rises to stationary point, parts of the metal still fluid.</p>
1	2	357 $\frac{1}{2}$	2	
1	3	357 $\frac{1}{2}$	1	
1	4	358 $\frac{1}{2}$	2	<p>Thermometer fell to 365°, rose rapidly to 369°, where it was stationary for a short time, then fell to 357<math>\frac{1}{2}</math>°, where it was stationary for some minutes.</p> <p>Thermometer was 30 secs. in falling from 369<math>\frac{1}{2}</math>° to 362<math>\frac{1}{2}</math>°, very slow: stationary at 357<math>\frac{1}{2}</math>° for 100 secs. No other stationary point to 200°.</p> <p>Thermometer stationary at 377°, in one experiment, then fell to 358°, stationary 35 secs.: at 377° soft solid, easily penetrated, hard at lower stationary point. In another expt. fell to 377°, then rose to 379°, whence it fell rapidly to 358<math>\frac{1}{2}</math>°, the lower stationary point.</p>
1	5	357 $\frac{1}{2}$	5	
1	6	358 $\frac{1}{2}$	4	
1	6	358 $\frac{1}{2}$	4	
Equivalents of		Stationary point.	Number of Observations of which the stationary point is the mean.	REMARKS.
Common Lead.	Block Tin.			
1	1	354 $\frac{1}{2}$	1	<p>At 408<math>\frac{1}{2}</math>°, a stick only pierces the surface, solid below. Thermometer fell to 352°.</p> <p>Parts of the alloy liquid at stationary point.</p>
1	2	357 $\frac{1}{2}$	5	
1	3	357 $\frac{1}{2}$	1	
1	4	359 $\frac{1}{2}$	2	<p>In one experiment therm. rose from 366<math>\frac{1}{2}</math>° to 367°, alloy granular, semi-solid; fell to stationary point, alloy solid. By stirring the upper point was obliterated.</p> <p>In one experiment the therm. rose half a degree from 376<math>\frac{1}{2}</math>°, then fell rapidly to stationary point.</p> <p>Therm. rose half a degree above 383<math>\frac{1}{2}</math>°, in one experiment, and was stationary a short time at 381<math>\frac{1}{2}</math>°, in another experiment; at both these times the metal was beginning to lose fluidity. Solid at lower stationary point.</p> <p>Thermometer fell very slowly from 387° to 386<math>\frac{1}{2}</math>°, and alloy began to congeal at surface.</p>
1	5	360 $\frac{1}{2}$	2	
1	6	359 $\frac{1}{2}$	2	
1	7	359 $\frac{1}{2}$	1	
1	7	359 $\frac{1}{2}$	1	

Upon this table we remark, first, that at all the stationary points, except in the alloy of 1 lead to 2 tin, the metal was solid at the stationary point; second, that although the proportion of tin varied from one to six, and even to seven, the stationary point was not changed more than  $3\frac{1}{2}^{\circ}$  for the first series, and  $5\frac{1}{4}^{\circ}$  for the second; third, that in the proportion of one of lead to four of tin, a second stationary point appeared at the point at which the metal began to lose its entire fluidity, and was found in the higher parts of the series, rising with the increased proportion of the more fusible metal, with difficulty detected at times, and disappearing by agitation of the alloy; fourth, that the tin and lead of commerce give, for the lower stationary points in the same alloys, quantities nearly the same. A comparison of the upper stationary points appears below.

Equivalents of		Upper Stationary Point for Pure Metals.	Upper Stationary Point for Common Metals.
Lead.	Tin.		
1	4	369°	367°
1	5	369	376 $\frac{1}{2}$
1	6	378	382 $\frac{3}{8}$

The variable nature of the results, seems to point out rather the difficulty of detecting the upper point and the effect of accidental circumstances, than that it is affected materially by the impurity of the metals as found in commerce. This upper point rises with the proportion of the less fusible metal. The number of degrees between it and the corresponding point, for the solid state of the metal shows one difficulty to be obviated in the use of the fusible alloys. For example, the first in the table, just given, has  $10\frac{3}{4}^{\circ}$  between the point at which it begins to lose fluidity, and that at which it is solid; the second has  $11\frac{1}{4}^{\circ}$ , and the third  $29\frac{3}{4}^{\circ}$ ; these defects, it was hoped, would not have been found in alloys in definite proportions. They indicate that the variety of combinations in definite proportions is not considerable, if even it exceeds a single one; and that when the metals are mixed in definite proportions, the alloys are in fact combinations, or mixtures, of one or more chemical compounds with the metals themselves. If this be the case with alloys in which the proportions are in the ratio of the equivalents or in multiple ratios, it would seem to follow certainly, that in alloys made in proportions not definite, the same fact would appear. That this is so, and that its effects are of importance in practice, will appear subsequently.

The second part of the inquiry relates to the action of fusible plates when in place on the boiler; it supposes proper alloys, fusing at required temperatures, to be composed, and then studies the causes, modifying the action of them when placed on the boiler. In the first apparatus for the use of these plates, the attempt was made to introduce them within the boiler, but the difficulty of replacing a plate which had fused by another plate, led to the abandonment of this apparatus. The opening made in the boiler, when the plate was withdrawn, was so great that the contents of the boiler were violently discharged through it, before the operation of replacing the plate could be effected. This observation has a bearing upon the plans for making large openings in boilers of full size, to avoid explosions.

The apparatus finally used was a sliding plate, moving in a groove upon the upper side of the boiler, as shown in Plates 1 and 3, where *s* represents the slide moved by the lever *r*; in the middle of the slide was an aperture slightly conical, for receiving the fusible plate, this aperture was eight-tenths of an inch in diameter. By means of the lever, the plate could be brought over an opening in the top of the boiler, or the solid part of the slide might be made to cover the same opening. The fusible plate was covered by a disk of brass, the edge of which projected over the plate, and rested upon the slide. There were six holes drilled through this plate, each being about nineteen-hundredths

of an inch in diameter. To retain the slide in its place, when pressed from below, and to retain the fusible plate when in a similar situation, the forked stem, *L*, pressed in the former position by one leg, upon the slide, *s*, in the other by the other leg upon the disk covering the fusible plate; the upper end of the stem entered a cavity in an adjusting screw, *t*, passing through the gallows, *u*; by this means allowance could be conveniently made for expansion. The lever for moving the slide rested, when the aperture in this latter for receiving the fusible plate coincided with the opening in the boiler, against an upright, projecting from the top of the boiler, and serving as a stop. By the use of this apparatus, the plates were applied very readily, were removed when fused, and the opening into the boiler closed with so much despatch as to prevent the foaming within from taking effect. The disk which covered the fusible plates, prevented in part the loss of heat from the upper surface.

The plates which were first cast, were intended for low pressures as most convenient for experiment, they were fifteen-hundredths of an inch in thickness. The observations made upon the manner in which they acted when in place upon the boiler, led to the question of the effect of varying the thickness upon their use. When a plate of sufficient thickness to prevent its giving way to pressure, verges towards its point of fusion; the top part, which is in contact with the metal disk, melts, and flows over the holes in the disk; sometimes it accumulates until the liquid rolls off the plate. The temperature rising, a small pellet of the more perfectly fused parts is thrown out by the steam, the flow of which is instantly checked; this is repeated frequently, until a breach through the plate is made, and the uninterrupted flow of steam takes place. If the plate be removed at once, a very small hole appears, which would gradually have been widened by the action of the escaping steam, probably before the entire fusion of the plate. The under surface of the plate appears oxidized and the fusion to have taken place at the top: the plate has contracted in its dimensions, and the periphery of the upper surface has lost its circular figure, which is tolerably well preserved by the lower surface. To give some idea of the extent to which a plate such as just supposed, may lose its substance before giving way, two measurements are subjoined. Before fusion, the diameter of the upper surface of the plates was eighty-four hundredths of an inch; the lower diameter eighty-two hundredths of an inch; the thickness of the plates, fifteen hundredths. After the plate had given way, the diameter of the hexagonal figure into which both the surfaces had passed, was about seventy-nine hundredths for the first, seventy-four hundredths for the second; the diameter of the lower surface, which was still nearly circular, was, for the first, seventy-six hundredths; for the second, sixty-nine hundredths; the thickness of the first was about twelve-hundredths, of the second, one-tenth of an inch; the thickness not being uniform in all parts. The first plate had lost, therefore, nearly three-tenths, and the second half of its substance, without allowing the passage of steam.

The observed oxidation of the lower side of the plate, led to the supposition that it might retard the fusion of the plate, but no confirmation of this view was given by comparative experiments, with plates of which the lower surface was brightened, and of others in which the same surface was highly oxidated, the thickness in each case being the same.

In the course of the experiments on the effect of oxidation, the plates were much reduced in thickness by filing away the under surface, and the fusion of the thinner plates took place at points so much lower than those at which the thicker plates of the same alloy gave way, so as to require an examination of the cause.

Before proceeding with further detail, it may be well to state the general method of experimenting upon the plates. The stationary point of an alloy having been determined, and remarks made as to its point of fusion, plates

were cast from it; and one of these being placed in the opening in the slide of the apparatus already described, was covered with the pierced disk, and the slide moved so as to bring the plate over the opening in the boiler. The steam was now raised, the temperature being noted from time to time, until the plate gave way; steam was then let off to keep the temperature from rising; the plate, which had just fused, removed, and one of an alloy, fusing at a higher temperature, substituted. The steam was again retained, and allowed to rise in temperature, the new plate pushed to its place, and the operation renewed. This course was continued until the alloy, fusing at the highest point of those prepared, had been used, or until the limit of the elasticity of steam, which could be produced in the actual condition of the boiler and state of the fire, was attained; steam was then let off, water thrown into the boiler, and a new series commenced. The tables which will be given, required many days of trial, and of close attention.

To try the effect of thickness on the fusion of the plates, three different thicknesses were cast of each of the alloys used; the first, or thickest, was fifteen-hundredths of an inch thick; the second, eight-hundredths; and the third, four-hundredths. There were five different alloys of tin, lead, and bismuth, composed; the stationary points of which, and the points at which they gave way in the boiler, appear below.

Number of experiment.	Number of alloy.	Temp. at which alloy begins to lose fluidity.	Stationary point determined by committee.	Thickness of plate.	Point at which the plates gave way in boiler.			Mean.	Pressures corresponding to the mean temperature of giving way.	
				Inch's.						
1	1	275	250*		248	249†	249	248.3	1.9	* No true stationary point. Soft solid 250° to 254°. † Plate blown to pieces.
2	"			.08	243		251	245.5		
3	"			.15	250			250	1.95	
4	2	281‡	268‡		263	258		260.5	2.3	‡ Had another stationary point at 207°.
5	"			.08	254½			254.5		
6	"			.15	295	295§	292	294	4.2	
7	3		284		287	288	285½	286.8	3.7	§ Piece of plate blown out.
8	"			.08	290	298		294		
9	"			.15	296	303	304	301	4.6	
10	4	314	309½	.08	299			299	4.5	
11	"			.15	303			303	4.7	
12	5	328	320		298	299	298	298.7		
13	"			.15	314			314	5.7	

The plates of experiments 1, 2, and 3, were exposed to pressures tending to render them of less than one atmosphere; 1 and 3, the two extremes of thickness, show a great uniformity in the point at which they give way, and render it probable that some flaw, in casting the plate number two, caused its fusion at a lower point than that of either of the others; we see too, that at

these low pressures the fusing point in the boiler coincided, very nearly, with the point at which the alloy was a soft solid in the crucible. In this case the thinnest plates, when properly cast, were probably thick enough to withstand the small pressure to which they were exposed, and therefore did not give way at lower temperatures than the thickest, each attaining the temperature at which they were soft solids.

The next series, Nos. 4, 5, and 6, with a less fusible alloy, show, first, that the thinnest plate was too feeble to resist the pressure of steam, and gave way before the metal lost its solidity; second, that the plate, eight-hundredths of an inch, was probably defective, as it gave way at a lower temperature than the thinner plates of No. 4. No. 6 presents a curious fact; the point of yielding of the plate, given by four experiments, is actually above the point at which the alloy from which it was composed became liquid: this would appear inexplicable to one who had not attentively observed the mode of fusion of these thick plates, and would lead to the suspicion of error. The observation of the point at which the alloy became liquid, was however, deduced from three trials; and four experiments, with the plates in place, are given, the extremes differing but three degrees. The explanation is to be found in the mode of fusion already spoken of; the more liquid parts of the alloy are forced out, the less fusible remain, and if strong enough to resist the pressure, the process goes on; this takes place, unequally, in different alloys. The importance of attending to such indications is obvious.

In the next series, the first thickness seems to have been decidedly too weak, and the second to have been hardly sufficient, while the third exhibits a point of fusion when the metal was in a softened state.

In the remaining experiments, both thicknesses were too inconsiderable to sustain the pressure, as appears by comparing the points at which the plates gave way, with the stationary points. Something of this kind seems to have been deduced from practice in the use of these plates in France, for the last royal ordinance, in relation to the means of safety to steam-boilers, prescribes for the plates a thickness of not less than nine-sixteenths of an inch, making of them fusible plugs rather than fusible plates.

Experiments were subsequently made on plates of greater thickness, the use of which led to an interesting termination to this series of experiments. Before, however, stating the results thus obtained, some further experiments with the plates just considered, will be described. These inquiries were directed to the effect which would be produced by the mode of casting the plates, upon their fusibility; it being not improbable that rapid cooling might so modify the physical properties of the alloy, as to change the fusing point from that of the same alloy when slowly congealed.

As low pressures afforded the most easy means of determining this point, plates were cast from the alloys of series No. 1, No. 2, and No. 3, and tried, in place, upon the boiler. Some of the plates were cast from metal at a high temperature, and the mould as cold as the perfect casting permitted; others, of the same alloy, in a heated mould allowed to cool slowly; and others from metal heated to a temperature as little above the point of fusion as possible. In the case of the higher temperatures, care was taken not to raise the heat so far as to oxidate rapidly either of the constituents of the alloys, thus changing the fusing point. A comparison of the results obtained, showed no greater differences than those which have been seen to occur between plates similarly cast, and from the same alloy; and the conclusion derived was, that the mode of casting has no effect on the fusing point, which is appreciable in this mode of applying them. The French instructions expressly recommend to those

who make or use boilers, to obtain plates in preference to the fusible metal in ingots; on the ground that it will be found difficult to procure plates of the same fusibility with the ingot, from that form of the alloy. This remark led to the experiments just referred to, and the explanation of it which they give, refers to the undue heating of the alloy in the casting of the plates, since they show that the particular mode of casting produces no difference worthy to be regarded in a practical point of view.

Plates were now cast quite thick, viz.—one-fourth of an inch, of the alloy of eight parts of bismuth, eight of tin, and seven of lead; this alloy being intended to give way at a temperature corresponding to about one atmosphere of bursting pressure. The alloy was completely liquid at 275° Fah. and solid at 254° F.,\* when examined in the crucible. The heat was raised as slowly as possible, so as to permit the full effect of the temperature indicated by the thermometer; the observations recorded are as follows:—

Thermometer in Steam.		Therm. on top of boiler.	Pressure.	REMARKS.
Therm.	Scale.			
Fah.°	Fah.°	Fah.°	Atmos.	
256	58		2.2	Plate ¼th of an inch. Metal stands fused in the holes of the brass disk covering the fusible plate.
260		254		Steam issues in a very small stream through chinks between the fused metal and an unmelted part within.
270	58	262	2.7	Steam issues as before; no clear passage through the plate. Steam kept for a long time at this temperature. Six minutes elapsed in raising temperature 4½ degrees.
292		279	4.0	Plate gave way, affording a free passage to steam.
258				A second plate of the same composition and thickness, put in place; fluid metal stands in the holes of the cap.
267	83		2.6	Metal which has oozed out remains in a fluid state upon the sliding plate of the apparatus.
299	93		4.5	Plate gives way, torn in a thin part.

The thermometer on top of the boiler dipped into the mercury in a small cistern, made by inclosing a space on the top of the boiler, with clay; so that the top of the boiler formed the bottom of the cistern. The first plate having failed to give way until the temperature within the boiler was twenty-four degrees above that at which the alloy, of which it had originally been composed, had been fluid, was examined with great care. The plate had decidedly given way to pressure, and not by fusion; it had lost its metallic lustre at the side where it was torn; yielded readily to the nail, which scraped off small particles. A piece of the plate being cut off and laid upon the top of the boiler, remained solid, though the portion which had oozed out, was perfectly fluid, near the same spot. The same remarks apply, generally, to the second plate. They afford a solution of the perplexing circumstances, which had occurred throughout these experiments, and which had led to so many trials to discover their cause.

The portions of the metal which oozed out from these two plates had their fusing points taken, by gradually raising their temperature in a bath of oil, while the alloy rested on a small shelf of copper, wholly immersed in the oil. The first portions of fluid metal which had oozed from both the first and second plates, melted at between 221 and 223 degrees, Fah., being solid at the lower, and perfectly fluid at the higher, of these two temperatures. The

\* This alloy had no stationary point in passing from the liquid to the solid state; but some internal change in the solid at about 206°, produced a rise and stationary point at 203°.

second portion which oozed out from the first plate, fused at between  $230^{\circ}$  and  $233^{\circ}$ , Fah., and a portion of that from the second plate was fluid at about  $235\frac{1}{2}^{\circ}$  Fah. The parts which were left, of the first plate, were a soft solid, at  $299\frac{1}{4}$ , fluid at one edge, at  $312^{\circ}$ , and entirely fluid at  $345^{\circ}$ .

The portions left, of the second plate, lost their cohesion, and could be broken by pounding, into small particles or grains, at  $300\frac{1}{4}^{\circ}$ ; and the whole was fluid at  $356^{\circ}$  Fah. A comparison of these results appears in the annexed table.

	First ooze.	Second ooze.	Residuum.	Entire plate before experiment.
	Fluid.	Fluid.	Fluid.	Fluid.
First plate, - -	$223^{\circ}$	$233^{\circ}$	$312 \text{ a } 345$	$254 \text{ a } 275$
Second plate, - -	$223$	$235\frac{1}{2} \text{ a } 241\frac{1}{2}$	$356$	

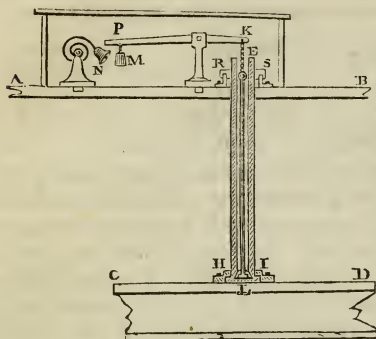
To pursue this subject further, by the clue thus obtained, only freeing the different oozes from accidental admixture, a small iron cylinder was made, closed at one end, and perforated near the closed end with a number of minute holes, not larger than the stem of a common pin. Into the cylinder was fitted, nearly tight, an iron piston, with a rod, to apply pressure. An alloy having been made and introduced into the cylinder, the whole could be heated in an oil bath to any desired temperature; and pressure being applied to the piston, the liquid parts would ooze out, through the small apertures near the end of the tube. The first alloy experimented upon was the same in composition with that just referred to; being composed of eight of bismuth, eight of lead, and seven of tin, by weight. This alloy was fluid at  $254\frac{1}{4}^{\circ}$  Fah. At a temperature of  $229^{\circ}$ , some drops of fluid metal were forced out by pressure, and at about  $239\frac{1}{2}^{\circ}$  other portions were forced out. Both melted at  $227^{\circ}$  Fah. The portion left was a soft solid at  $276\frac{3}{4}^{\circ}$  Fah.; fluid at  $290\frac{1}{2}^{\circ}$ . The alloy of one atom of lead, one of tin, and one of bismuth, is fluid at  $273\frac{1}{2}^{\circ}$  Fah., and that of one atom of lead, one of tin, and two of bismuth, at  $219^{\circ}$  Fah.

These experiments, the committee deem conclusive in regard to the use of fusible plates in the ordinary way, and they conceive that substituting fusible plugs of greater thickness, say half an inch, as has been directed by a recent ordinance in France, would not serve as a remedy to the defect thus exposed. The true remedy is to be sought in inclosing the fusible metal in a case, in which it shall not be exposed to the pressure of the steam, but only to its heating effect: the more fluid parts of the metal will then not be exposed to be forced out of the mass; and the whole will become fluid as if exposed to heat in a crucible. With this view of the subject, trial was made of an apparatus described by Professor A. D. Bache, in the Journal of the Franklin Institute, for October, 1832, under the title of an "alarm to be applied to the interior flues of steam-boilers."\* This apparatus is obviously as applicable to a common boiler as to one with interior flues; the following description of it is given in the journal.

"A tube of iron, or copper," according to the material of the boiler, "closed at the lower end, passes through the top of the boiler, its closed end reaching the flue to which it is attached." "This tube, it will be observed, affords a ready access to the flue, to ascertain its temperature, without any restraint from packing." "A mass of fusible metal placed at the bottom of the tube," "will become fluid very nearly as soon as the flue takes the temperature of fusion of the alloy." "To show when the metal at the bottom of the tube becomes fluid, a stem is attached with a cord and weight," "or with a lever and weight." "The weight and longer arm of the lever, descending, may be

\* This paper was published in 1832, and the experiments of the Committee were made in 1833-4.

“made to ring a bell, or, by appropriate attachments, to turn a cock, permitting just enough steam to issue to give the alarm, and then to be closed at once. A projection on the lower end of the rod prevents it from being drawn from the metal until this latter is fused, and by widening the lower part of the tube, making it slightly tapering, the metal is kept from being drawn out by the rod.”



In the annexed figure “AB is a section through the top of the boiler; CD, a corresponding section of its flue, EH represents a tube closed at the lower end, which is attached to the upper side of the flue. The mode of attachment by a projection on the tube and a ring screwed to the flue, is shown in the figure, as also the stuffing box, RS, through which the upper end of the tube passes. The lower part HI, of the tube, is made tapering, to retain the fusible metal. KL is the stem, the lower part being inclosed by the fusible metal, the upper part attached by a chain to a lever KP. The weight M, draws the rod KL upwards, and on the fusion the alloy HI, carries the lever below the bell N, which, being attached to a spring, rings an alarm.”

The form of this apparatus, which was subjected to trial by the committee, was essentially the same with that described. One of the tubes in which the thermometers were ordinarily placed, was used to contain the fusible metal, and as giving the more severe test, the short one entering only into the steam, was selected. For the convenience of removing the metal, it was placed in a metallic case, fitting loosely into the iron tube, and having a wire attached, by which it could be drawn out of the tube. This certainly diminished the sensibility of the apparatus, particularly, as the case was quite as thick as the inclosing tube, and as there was a small space between its convex surface and that of the tube; it was required, however, for the convenience of the experiments.

The results of the several trials are contained in the following table. The temperature was registered by the adjoining thermometer dipping into the water of the boiler, and already often referred to; it was raised as rapidly as possible in all the experiments except the first. The first four trials were made on an occasion specially devoted to this purpose, the last two were made incidentally when upon another subject.

Number of Trial.	Tempera- ture.	REMARKS.
	Fah°.	
1	268	Stem rises. No particular attention paid to raising the temperature rapidly.
2	270	Stem rises. Steam raised rapidly.
3		Metal drawn out and suffered to cool, re-deposited cold in tube. Steam at 258°, and raised to 274° in 2½ minutes.
4	274	Stem rises. Metal drawn out and cooled. Steam at 250°, when metal was re-placed. Steam raised to 274° in 3 minutes.
	274	Stem rises.
	252	Metal had not become solid again. Steam let off rapidly.
5	270	Melted below this temperature.
6	256	Stem rises. Metal remains a soft solid, so that the stem can be drawn out, until 240°.

A fact noticed during the experiments on fusible alloys was again verified in these experiments; namely, that the mixtures of metals require a considerable time to change their state of solidity or of fluidity, so that in the former case they may be heated above the true temperature of fluidity, and in the latter case they may be cooled much below this temperature, without solidifying. The alloy used in these experiments, appears to have put the apparatus very fully upon its trial in this respect, and the experiments were performed so rapidly as to give a further severe test. On the occasion devoted to the trials when the steam was not urged up with its greatest rapidity, the stem was drawn out at  $268^{\circ}$ , when more rapidly at  $270^{\circ}$ , and with the fire at its maximum intensity, when the water was raised in temperature  $24^{\circ}$  in three minutes, the stem was drawn out at  $274^{\circ}$ . In other experiments it gave way at  $256^{\circ}$ . The range is  $18^{\circ}$  Fah., corresponding at ten atmospheres, to less than two atmospheres, under the test of very severe comparisons. There appears no reason to doubt, that when tested by no more rigid modes than practice would furnish, this apparatus would not only apply as an alarm to prevent undue heating of the parts of the boiler, but as a manageable, and useful check, in ordinary cases, upon the safety valve.

### Conclusions.

The conclusions deduced from the foregoing experiments, on metallic alloys, may be thus stated.

1st. The impurities of common lead, tin, and bismuth, are usually not such as to affect materially the fusing points of their alloys.

2d. When mixed in equivalent proportions, tin and lead formed alloys, not presenting the characters of distinct chemical compounds, in definite proportions. The alloys between the range of one equivalent of tin, to one of lead, and one equivalent of tin to six of lead, varied considerably in the interval between the temperature of commencing to lose fluidity, and that at which a thermometer, immersed in the solidifying metal, became stationary. These different alloys produced nearly the same stationary temperature in a thermometer plunged into the solidifying metal.

3d. Fusible metal plates covered by a perforated metallic disk, and placed upon a steam-boiler, show signs of fluidity at the disk, before the steam has attained the temperature of fusion of the alloy of which the plate is composed. This fluid metal oozes through the perforations in the disk, and the plate thus loses much of its substance before finally giving vent to the steam.

4th. The under parts of the plate are not kept from fusion by a protecting film of oxide there formed.

5th. The thickness of the plate is not important, provided only that it is sufficiently strong to resist the pressure of the steam at temperatures below its point of fusion.

6th. The temperature at which the plates are cast, and the rate of cooling of the cast metal, do not affect the temperature at which the plates give vent to steam.

7th. The effect stated in conclusion third, is explained by the nature of the alloys used, which are formed of portions of different fluidities; the more fluid parts, are forced out by the pressure of the steam, leaving the less fusible. These latter in general are burst, not melted.

8th. By pressure in a receptacle provided with small openings, this effect of separating the differently fluid portions of an alloy, may be imitated.

9th. Fusible alloys, used to indicate the temperature of any part of a steam

boiler, should not be exposed to the pressure of the steam; at least not in such a way that the separation of the differently fusible constituents of the alloys may be effected.

### *Fusing Points of Alloys applicable to Steam Boilers.*

The committee next proceed to give the results of their trials to determine metallic alloys proper to be applied to steam-boilers. This problem admits, of course, of a great variety of solutions. The metals used were limited to tin, lead, and bismuth; but still different mixtures of these may be made which will give alloys of the same fusing point. The property which was most desirable in these alloys was a small range of temperature in changing from the liquid to the solid state. This property, it will be seen, is difficult to attain, and the less fusible alloys of the first table, as well as the more fusible ones of the third, do not possess it. For the higher temperatures, alloys of lead and tin are applicable, and the question is reduced to an examination of the fusing points of different mixtures. The greater proportions of lead might be inferred to give the higher fusing points, and the less proportions the lower ones. Beginning with the alloy of equal weights of tin and lead, the following table gives fusing points between  $355^{\circ}$  and  $503^{\circ}$  Fah. The stationary points were taken as already described; all the alloys in the table, except the first, were hard before the stationary point occurred, and therefore this point indicated, in these cases, some internal change in the solid, and did not correspond to the passage from the liquid to the solid state. This seems not to have occurred to Mr. Parke, who speaks of having taken this point as corresponding to that of congelation. It should be observed, however, that his table of alloys shows a variety in the fusing points, which is incompatible with the observations of the committee, supposing the stationary point to have been taken in each case as the fusing point.

The alloys passing gradually from the fluid to the solid state, an attempt was made to seize the more remarkable points, as referred to in the table; but these can only be considered as approximately determined. Direct experiments were, in most cases, made upon the temperature at which the metal refused to allow a metallic stem to be withdrawn. This was the case when the metal, from the state of a soft solid, began to acquire hardness.

TABLE I. *Alloys solidifying between  $486^{\circ}$  and  $355^{\circ}$  Fah.*

Eight parts of Tin to Lead.	Begins to lose fluidity.	Loses fluidity.	Stem draws out.	Falls to.	Stationary.	Eight parts of Tin to Lead.	Begins to lose fluidity.	Loses fluidity.	Stem draws out.	Falls to.	Stationary.	REMARKS.
8	$393^{\circ}$	$355^{\circ}$			$355^{\circ}$	20	492	446	$416^{*}$	$351\frac{1}{2}$	354	* $415^{\circ}$ , with temperature rising.
10	$430\frac{1}{2}$	$375\frac{1}{2}$		354	355	23	521	480	466	$352\frac{1}{2}$	$353\frac{1}{2}$	† Hard solid, at $426^{\circ}$ .
12	445	393	380	352	354	26	529	503	486	†	353	‡ Hard at $437^{\circ}$ .
16	475	439	405	352	354							

The next object was to diminish the relative proportion of lead, so as to determine the most fusible alloy of the two metals. The results obtained will be seen in the following table. The lead was the same in each case; namely, eight parts by weight.

Parts.	Eight parts of Lead with Tin.	Liquid metal begins to thicken.	Stationary Temperature.	REMARKS.
8	364½*	352†	353†	* Began above this point. † In these three cases the alloy congeals in thin plates, at the surface, and is a sandy solid below, at the sides. A liquid, with solid portions, at stationary temperature.
			353½†	
9	368½	351		
10		354*	352½*	* Hardens in round masses, which, at the stationary point, are surrounded by a liquid.
	366½		352½*	
			352½*	
11			353½	
12			353	
16			352	

The table of alloys by Parke, before referred to, gives a considerable variation in the melting points of the alloys in the above table. He makes the stationary point of the alloy of eight to eight, 372° Fah.; that of eight lead and ten tin, 352°; that of eight lead to twelve tin, 336°; this latter being the most fusible of the alloys of lead and tin. That the alloy, in equal parts, has not a fusing point varying much from that just given, the committee were able to determine from various specimens of metal. With pure lead and grain tin, they found, for eight lead and nine tin, nearly the same as the foregoing, the stationary point to be, in different experiments, 355¾°, 356°, and 355½°. With one specimen of common lead the stationary point of an alloy of equal parts of lead and tin was 356° Fah. This lead melted at 606°, and the tin at 442½°. The committee have no greater reason to suspect the accuracy of their other results. In all these cases the stationary point occurs when the metal begins to solidify.

It appears, then, by the foregoing table, that very little change is effected in the fusing point of the alloy of equal parts of tin and lead, by increasing the quantity of the more fusible metal. A curious coincidence is shown between the stationary point of these alloys and of those in which the lead is increased. The two intervals, which are best determined in the table, between the temperature at which fluidity begins to be lost, and that at which the metal becomes solid, are seventeen and fourteen degrees. When the lead becomes considerable in quantity, the passage from the fluid to the solid state is by such minute mechanical changes, as to extend through a long series of temperatures. This is even more especially the case when bismuth also enters largely into the alloy; instructive examples of which occur in the following table.

Lead.	Tin.	Bismuth.	
20,	8,	8,	352° Fused metal begins to lose fluidity.
			307 Soft solid, penetrable.
			279 Stationary point.
22,	8,	8,	358 Fused metal begins to thicken.
			280 $\frac{3}{4}$ Stationary.
40,	8,	8,	466 $\frac{1}{2}$ Begins to thicken.
			368 $\frac{1}{2}$ Is a soft solid.
			337 $\frac{3}{4}$ Hard solid.
			280 $\frac{1}{4}$ Stationary point.
44,	8,	8,	474 $\frac{3}{4}$ Begins to thicken.
			429 $\frac{3}{4}$ Loses fluidity; is a soft solid.
			388 $\frac{3}{4}$ Hard solid.
			280 $\frac{1}{2}$ Stationary.
48,	8,	8,	481 Thickens.
			440 Loses fluidity.
			280 $\frac{1}{2}$ Stationary.

From perfect solidity to the greatest degree of fluidity of which the alloy was capable, required in the case of the first alloy given above, about seventy degrees of temperature: and between the temperature at which a solid could pierce the alloy, and the stationary temperature, was eight degrees. When the quantity of lead was doubled, the first interval was nearly one hundred and thirty degrees; and the interval between the temperatures of solidity and that at which the alloy could be penetrated easily, was about twenty degrees.

These facts show that in using fusible alloys, those should be preferred which contain the smallest quantities of lead: a similar reason would lead to the preference of those containing the smallest proportions of bismuth.

Tin is nearly liquid at the stationary temperature; hardens by plates or small masses, and becomes entirely solid at this same temperature.

Experiments were made to ascertain what quantity of bismuth could be added to tin without destroying the property just described. To one hundred parts by weight, of tin, one part, five parts and ten parts of bismuth, respectively, were added. The first alloy melted at 439 $\frac{3}{4}$ °, and had the general characters of tin in hardening; the second melted at 428°, and had these characters impaired; the third had no stationary temperature above four hundred degrees, and lost its fluidity by slow degrees.

As it was thus shown that alloys of tin and bismuth presented no peculiar advantages, the alloys for temperatures below 355°, Fah., were sought by combining the least quantity of bismuth which would give any requisite temperature with one of the alloys of the table on page 37. For this purpose the alloy of equal parts of tin and lead was selected as having appropriate characters in its solidification, and melting at nearly as low a temperature as any of the others in the table. It does not, of course, follow, that this alloy when combined with a given quantity of bismuth, will produce as low a fusing point as some other would; a question which, if it were worth deciding, experiment would determine. A few trials on this head were made by the committee.

The following table gives the proportions of bismuth, which, added to an alloy of eight parts of tin and eight of lead, will give the temperatures of the stationary points of an immersed thermometer between 355° and 326°. With the alloy which terminates this table, the stationary temperature near the fusing point disappears, and another form of table is required for description.

TABLE II. *Alloys of Tin, Lead, and Bismuth, melting between 355° and 326° Fah.*

Eight parts, by weight, of Tin, and eight of Lead.						REMARKS.
Bismuth.	Begins to lose fluidity.	Stationary point.	Bismuth.	Begins to lose fluidity.	Stationary point.	
0.0	393°	355°	1.0	362°	339 $\frac{3}{4}$ °	All these alloys are liquid with solid portions, when the thermometer becomes stationary.
0.2	387	351	1.4	347	335	
0.4	375	349	1.8	343	331	
0.6	369	345 $\frac{1}{2}$	2.2	331	326*	* Slow, not stationary.
0.8		342 $\frac{3}{4}$				

The stationary temperature having disappeared with the increase of bismuth, the points attempted to be ascertained were these; the temperature at which the metal began to lose fluidity; that at which it ceased to be a liquid, as indicated by the surface not returning to a level when indented; that at which the solid ceased to be penetrable to a small rod by moderate pressure; and when it became hard. As these temperatures present nothing as definite as the stationary temperature, they are, of course, only approximate. A few trials made on the withdrawal of a metallic stem from the alloy, showed that the temperature at which this ceased to be possible was, for the alloys in the following table, between the temperature at which the metal lost its fluidity, and that at which it could not be penetrated by moderate pressure.

TABLE III. *Alloys losing fluidity between 313° and 246° Fah.*

Eight parts, by weight, of Tin, and eight of Lead.									
Bismuth.	Begins to lose fluidity.	Begins to solidify.	Solid, not easily penetrated.	Hard, solid.	Bismuth.	Begins to lose fluidity.	Begins to solidify.	Solid, not easily penetrated.	Hard, solid.
2.6	326	313	307	301	5.4	296 $\frac{1}{2}$	280 $\frac{1}{2}$	270 $\frac{1}{2}$	264 $\frac{1}{2}$ *
3.0	321	313		297	6.2	294 $\frac{1}{2}$	269	261†	246
3.4	316	309	301	295 $\frac{1}{2}$	7.0	288 $\frac{1}{2}$	257	252‡	238
3.8	311	306	298 $\frac{1}{2}$	289 $\frac{1}{2}$	7.6	283 $\frac{1}{2}$	253	242§	234
4.6	301	291		271 $\frac{1}{2}$	8.0	272	246	232	226

\* Stationary at 205°.

† Stem drew out at 254°.

|| Stem drew out at 235°.

† Stem drew out at 264°.

§ Stem drew out at 245°.

The fusing points of the metals used in the foregoing alloys were, of the tin, 442° Fah., of the bismuth, 506°, of the lead, 612°.

*VI. To repeat the experiments of Klaproth, relating to the conversion of water into steam, by highly heated metal.*

It being now well understood that an increase of temperature in a metallic surface may diminish the amount of vaporization of a fluid placed upon it, the object of the following experiments was to study the phenomena attending the vaporization of water by iron and copper, under different circumstances.

1st. To ascertain the temperature, at which a given small quantity of water will be vaporized in the least time, by copper, with different states of surface.

2d. To ascertain the same point for iron, in similar circumstances.

3d. To extend these deductions to the effect of introducing different quantities of water into copper or iron vessels, varying in thickness, in character of surface, and heated by different sources, to various temperatures.

A number of bowls, of these different metals, of as nearly the same figure as could be obtained, and of different thicknesses, were provided. The bowls were portions of spheres, of nearly three inches radius, and were eight in number, three being of copper and five of iron; four of these latter were of wrought, and one of cast iron. For applying heat to the bowls, a cylindrical vessel containing oil, and another containing tin, were provided; the former was about nine inches in diameter, and four high, and the latter six and a half inches in diameter and four high. These vessels were heated by Mitchell's\* alcohol lamp, or in the very high temperatures, by a charcoal furnace. The bowls were furnished with handles, which projecting, overlapped the edges of the cylinders serving as baths for the oil and tin, and were thus kept in place.

The thermometers used in the experiments, were carefully compared at the boiling point of water, and melting point of pure tin.

The experiments first to be detailed, refer to the vaporization of drops of water in copper bowls of different states of surface, from the smooth polish to the roughness of oxidation.

*Vaporization of Drops of Water by Copper.*

1. The bowl, No. VII. of copper, seven-hundredths of an inch thick, was polished, but not very highly, and then placed in the tin bath while fluid; the tin, on solidifying, kept the bowl in its place. The thermometer was placed in a small cylinder of thin sheet iron, containing mercury, the cylinder being as near the cup as possible. As the experiments progressed, the surface of the bowl became, of course, more and more tarnished; and after the two series of results recorded below were obtained, a third showed a marked effect from the oxidation, by the increased vaporization. One hundred and twenty drops, nearly, from the tube used, made up one-eighth of a fluid ounce; the weight of one drop was, therefore, about .47 of a grain.

\* A very convenient alcohol lamp, with a draught through the wick, and a separation between the alcohol reservoir and the wick.—The invention of Dr. J. K. Mitchell.

Smooth surface. Copper bowl .07 inch thick.				
Descending Series.*			Ascending Series.	
Temp.	Drops on Centre.		Drops on Centre.	
Fah.°	Time.	Remarks.	Time.	Remarks.
	Secs.		Secs.	
315.3	$\left\{ \begin{array}{l} 5 \\ 3 \end{array} \right.$	On a polished part.		
317.3		On less polished.	3½	
319.3	> 2			
321.4	3		$\left\{ \begin{array}{l} 3 \\ 2\frac{1}{2} \end{array} \right.$	
323.4			2½	
325.4			2	
327.5	2		1¾	
329.5	2		1½	
331.5			2	
333.6	2½	Not repelled.	2	
335.6			> 2	
337.6				On a rough place, 1½ seconds.
339.7		Not repelled.		
341.7		A drop on side of bowl, 12 secs.		
343.8				
345.9				
348				
350	165	Repulsion perfect.		
352		Tempera. rising to 360°.		

The temperature of maximum vaporization, under these circumstances, appears to have been between  $327\frac{1}{2}^{\circ}$  and  $329\frac{1}{2}^{\circ}$  Fah., the two series coinciding nearly in their indications; the repulsion is shown to have been perfect at  $350^{\circ}$ , the drop falling upon the centre assuming the usual rotary motion, and disappearing very slowly.

2. The surface of this same bowl was next highly polished with rotten stone

\* In this and other tables, the series marked descending, are those obtained when the temperature was falling; the ascending series were obtained while the temperature of the bath was rising.

and oil, and a similar method of experimenting gave the following results, the same bath being used.

Polished Copper Surface.		
Descending Series.		
Temperature.	Drops on Centre.	
	Time in Secs.	Remarks.
445	210	Perfectly repelled.
370.5	177	Do.
331.6	157	Do.
318.3	25	Repulsion obviously lessened.
313.2	9	Repulsion not perfect.
300	4	
291.6	3½	
"	3	
285.5	4	
284.5	4½	
279.4	5½	
275.4	6½	
271.3	5½	
267.2	6	
255	16½	

(To be continued.)

*Reply to the Query in regard to the Coating of the Pipes forming the Condenser at the Philadelphia Gas Works.*

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen,—Your correspondent, in his query proposed in the last number of this Journal, has fallen upon a disputed point of science ; but I will endeavour to furnish the grounds for deciding his question, according to the conflicting authorities.

The object of the pipes, to which he refers, is to condense, in part, the moisture and other easily condensable matters, which come over with the heated gas from the retorts, previous to its entrance into the purifiers, where it circulates in contact with lime. This object is attained by a series of vertical

pipes, connected at the top, and passing at the bottom into large boxes, with vertical partitions, not extending quite to the bottom of each box. The gas passes through the pipes and their boxes in succession, circulating from one end to the other of the series, being thus exposed to the cooling action of the metal of the pipes and boxes. In the latter the condensed substances collect, and are removed by suitable openings.

Whatever means, then, will tend to allow the escape of heat from the metal of the condensers, will promote their efficiency. The air without, and the surrounding bodies, are supposed cooler than the gas passing through the pipes, which will be true, except in extraordinary cases.

The heat of the gas will be carried off more rapidly as the exterior surface of the condenser is kept cool. In this case, the surface will be cooled in two ways,—by contact of the air, and by radiation. The air adjacent to the pipes becoming heated, by contact with them, will rise, giving place to cool air; this will, in turn, be heated, and rise, continuing the cooling operation.

Besides this, heat is radiated from the surface of the pipes, which, if not restored by radiation from surrounding bodies, serves also to cool them.

It has been established by careful experiments,\* that the nature of the surface of contact of air and a body, the extent of surface remaining the same, has no influence on the cooling produced by the contact of a gas. Therefore, whether the paint upon the condensing pipes was of white lead, or lamp black, or any other material, there would be no difference in the cooling effect by contact.

As to the cooling effect of radiation, there is not such certainty. Doctor Stark, of Edinburgh, has endeavoured to show that black substances radiate better than white ones. He has made a few experiments, directly applicable to the subject, which, as far as they go, warrant this conclusion. If it be correct, the condensers should have been painted black. When the sun is not directly shining upon them, they would radiate better than white. When the sun is upon them, the absorption of heat being greater than it would be if the pipes were white, the cooling effect will be considerably diminished. As, however, the condenser is attached to the north wall of a building which is higher than the pipes, the sun will never reach it, except early in the morning, and late in the afternoon, even at midsummer.

On the contrary, your Journal for November contains an extensive series of experiments, by Prof. A. D. Bache, in which colour does not appear to influence the radiation or absorption of heat unaccompanied by light. The experiments were made by a similar method to that used by Doct. Stark. One of them, which is to the point now before us, was as follows: A small cylinder, filled with warm water, and allowed to cool in the air, required 817 seconds to cool through forty degrees of Fahrenheit's scale, when coated smoothly with India ink; and 846 seconds when coated with white lead, laid on with gum. The ratio of the times of cooling is 1 to 1.03, or within what is stated to be the limit of error in the method of experimenting. It might very well happen that a small difference in the thickness of the two coatings of white and black paint, would produce more effect than this difference of the radiating powers of white lead and lamp black, supposing them to be as just deduced.

It is now well known that the laws which apply to heat, accompanied by

\* Petit and Dulong, *Ann. de Chim. et de Phys.*, 1817.

† Inquiry into the alleged Influence of Colour on the Radiation of non-luminous Heat, &c., p. 291, vol. xvi. of this Journal.

light, do not apply to non-luminous heat; hence, there is no discrepancy between the experiments just adverted to, and those of Franklin, in which is shown the greater effect of black cloth than of white, in absorbing the heat from the sun's rays. According to the conclusions from the experiments of Prof. Bache, *the condensers are correctly coated*. For when the sun is not shining upon the pipes, the white paint radiates heat as well as black would; and when the sun does shine upon them, the white absorbs less of the heat accompanying the light, than black would do. The coating of white paint should be thick to derive the full effect from its radiating power, which increases with the thickness up to a certain point, above which the diminution is very slow. U.

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*On the rights of Patentees, with a letter of Mr. Jefferson on that subject, first published in Niles' Register, and afterwards in the 2d vol. of the Emporium of Arts, new series, p. 446.*

We have had repeated, we might almost say perpetual, occasion to remark upon the claims of patentees to what they denominate the *application* of a machine, or instrument, to certain purposes for which it has not been previously used. We accord with Mr. Jefferson, most fully, in many of his observations on that subject, although we do not go with him to the full extent on certain points, as we believe that there are cases where a machine already used in one manufacture, may be beneficially employed in another; and that a patent may be sustained for so employing it; but in this case the patent must not be for the machine, but for "an improvement in the art" to which it is applied. Thus, for example, if a person can introduce into the silk manufacture any apparatus by which a large proportion of the expense attending the ordinary process is saved, he has *improved the art of manufacturing silk*, although he may not have invented any new machinery, but merely have applied that already known so as to produce decided improvements. If substances had heretofore been pulverized in a mortar by repeated blows of a pestle, and some one was to discover that the same effect might be produced in half the time by a rubbing motion of the same instrument, he would be well entitled to a patent for an improvement in the art of using the pestle and mortar, or rather in the art of pulverizing hard substances by means of the pestle and mortar, but to the instruments themselves he must not make any claim.

There is a very frequent want of discrimination in the applicants for patents as respects the head under which they make their claim to invention or discovery. The objects patentable under the law are "any new or useful art,—machine,—manufacture,—or composition of matter;—or any new and useful improvement in any art,—machine,—manufacture,—or composition of matter, &c." Now all these are different things, and they ought to be designated accordingly in an application for a patent. If velvet had never been made, the making of it would be "a new manufacture" and might be patented as such; the mode of making it, however, must be described, and this might consist entirely in the use of well known machinery.

The letter of Mr. Jefferson was elicited by queries respecting the patent of Oliver Evans, at that time under litigation; but with that question our republication of it has nothing to do. Individually, we are of opinion that Oliver Evans was very hardly dealt by, although we admit that the course adopted by him was in some instances unwise; but of one thing there can be no doubt, namely, that he found the grain mills of this country in a very imperfect

state, and that he introduced and perfected those improvements which have rendered them models for the whole civilized world, and that for all he did in this way, his expenditures were greater than his receipts. [Editor.]

*Letter of Mr. Jefferson.*

MONTICELLO, Aug. 13th, 1813.

Your letter of August 3d, asking information on the subject of Mr. Oliver Evan's exclusive right to the use of what he calls his Elevators, Conveyers and Hopperboys, has been duly received. My wish to see new inventions encouraged, and old ones brought again into useful notice, has made me regret the circumstances which have followed the expiration of his first patent. I did not expect the retrospection which has been given to the reviving law; for although the second proviso seemed not so clear as it ought to have been, yet it appeared susceptible of a just construction; and the retrospective one being contrary to natural right, it was understood to be a rule of law, that where the words of a statute admit of two constructions, the one just and the other unjust, the former is to be given them. The first proviso takes care of those who had lawfully used Evans' improvements under the first patent; the second was meant for those who had lawfully erected and used them after that patent expired, declaring they "should not be liable to damages therefor." These words may indeed be restrained to uses already past; but as there is parity of reason for those to come, there should be parity of law. Every man should be protected in his lawful acts, and be certain that no ex post facto law shall punish or endamage him for them. But he is endamaged if forbidden to use a machine lawfully erected at considerable expense, unless he will pay a new and unexpected price for it. The proviso says: that he who erected and used lawfully shall not be liable to pay damages; but if the proviso had been omitted would not the law, construed by natural equity, have said the same thing? In truth both provisos are useless. And shall useless provisos, inserted pro majori cautela, only authorize inferences against justice? The sentiment that ex post facto laws are against natural rights is so strong in the United States, that few, if any, of the State Constitutions have failed to proscribe them. The Federal constitution indeed interdicts them in criminal cases only; but they are equally unjust in civil as in criminal cases: and the omission of a caution which would have been right, does not justify the doing what is wrong; nor ought it to be presumed, that the legislature meant to use a phrase in an unjustifiable sense, if by any rules of construction it can be even strained to what is just. The law books abound with similar instances of the care the judges take of the public integrity. Laws moreover abridging the natural rights of the citizen, should be restrained by rigorous constructions within their narrowest limits.

Your letter, however, points to a much broader question, whether what have received from Mr. Evans the new and the proper name of Elevators are of his invention: because, if they are not, his patent gives him no right to obstruct others in the use of what they possessed before. I assume it as a lemma, that it is the invention of the machine itself which is to give a patent right, and not the application of it to any particular purpose of which it is susceptible. If one person invents a knife convenient for pointing our pens, another cannot have a patent right for the same knife to point our pencils. A compass was invented for navigating the sea; another cannot have a patent right for using it to survey land. A machine for thrashing *wheat*

has been invented in Scotland; a second person cannot get a patent right for the same machine to thrash *oats*; a third *rye*; a fourth *peas*; a fifth *clover*, &c. A string of buckets is invented and used for raising water, ore, &c., can a second have a patent right to the same machine for raising wheat, a third *oats*, a fourth *rye*, a fifth *peas*, &c.? The question then whether such a string of buckets was invented first by Oliver Evans, is a mere question of fact in mathematical history. Now turning to such books only as I happen to possess, I find abundant proof that this simple machinery has been in use from time immemorial. Doctor Shaw, who visited Egypt and the Barbary coast in the years 1727—8, 9, in the margin of his map of Egypt, gives us the figure of what he calls a Persian wheel, which is a string of round cups, or buckets, hanging on a pully, over which they revolve, bringing up water from a well, and delivering it into a trough above. He found this used at Cairo, in a well 264 feet deep, which the inhabitants believe to have been a work of the patriarch Joseph. Shaw's Travels, 341, Oxford edition of 1738, in folio, and the Universal History, I, 416, speaking of the manner of watering the high lands in Egypt, says—"Formerly they made use of Archimedes' Screw, thence named the Egyptian Pump; but they now generally use Wheels (Wallowers) which carry a rope or chain of earthen pots, holding about 7 or 8 quarts a piece, and draw the water from the canals. There are besides, a vast number of wells in Egypt, from which the water is drawn in the same manner to water the gardens and fruit-trees; so that it is no exaggeration to say, that there are in Egypt above 200,000 oxen daily employed in this labour." Shaw's name of Persian wheel has been since given more particularly to a wheel with buckets, either fixed or suspended on pins at its periphery. Mortimer's Husbandry, 1, 18, Duhamel, V. Ferguson's Mechanics, plate 13. But his figure, and the verbal description of the Universal History, prove, that the string of buckets is meant under that name. His figure differs from Evans' construction in the circumstance of the buckets being round, and strung through their bottom on a chain; but it is the principle; to wit, a string of buckets, which constitutes the invention, not the form of the buckets, round, square, or hexagon; nor the manner of attaching them, nor the material of the connecting band, whether chain, rope or leather. Vitruvius, L. X. c. 9, describes this machinery as a windlass, on which is a chain descending to the water with vessels of copper attached to it; the windlass, being turned, the chain moving on it will raise the vessels, which, in passing over the windlass, will empty the water they have brought up into a reservoir: and Perault, in his edition of Vitruvius, Paris, 1784, folio, plates, 61, 62, gives us three forms of these water elevators, in one of which the buckets are square, as Mr. Evans' are. Bossut, Histoire des Mathematiques, I. 86, says, "The drum wheel, the wheel with buckets, and the *chapelets*, are hydraulic machines, which come to us from the ancients; but we are ignorant of the time when they began to be put into use." The *chapelets* are the revolving bands of buckets, which Shaw calls the Persian wheel, the moderns a chain pump, and Mr. Evans, elevators. The next of my books, in which I find these elevators, is Wolf's Cours de Mathematiques, I. 370, and plate 1, Paris, 1747—8vo. Here are two forms; in one of them the buckets are square, attached to two chains, passing over a cylinder or wallower at top, and under another at bottom, by which they are made to revolve. It is a nearly exact representation of Evans' elevators. But a more exact one is to be seen in Desagulier's Experimental Philosophy, II, plate 34. In the Encyclopedie de Diderot et D'Alembert, 8vo. edition de Lausanne, 1st. vol of

plates, in the four subscribed "Hydraulique, noria," is one, where round earthen pots are tied by their collars, between two endless ropes, suspended on a revolving lantern or wallower; this is said to have been used for raising ore out of a mine. In a book which I do not possess, "L'Architecture Hydraulique de Belidor, the II vol. of which is said [De La Lande's continuation of Montucla's *Histoire des Mathematiques*, III. 711] to contain a detail of all the pumps, ancient and modern, hydraulic machines, fountains, wells, &c. I have no doubt this Persian wheel, chain pump, chaplets, elevators, by whichever name you choose to call it, will be found in various forms. The last book I have to quote for it, is Prony's *Architecture Hydraulique*, I. advertisement VII. and secs. 648, 649, in the latter of which passages he observes, that the first idea which occurs for raising water is to lift it in a bucket by hand; when the water lies too deep to be reached by hand, the bucket is suspended by a chain and let down over a pully or windlass; if it be desired to raise a continued stream of water, the simplest means which offers itself to the mind is to attach to an endless chain or cord a number of pots or buckets, so disposed that the chain being suspended on a lantern or wallower above, and plunged into water below, the buckets may descend and ascend alternately, filling themselves at bottom, and emptying at a certain height above, so as to give a constant stream.—Some years before the date of Mr. Evans' patent, a Mr. Martin of Caroline county, in this state, constructed a drill plough, in which he used the band of buckets for elevating the grain from the box, into the funnel which let them down into the furrows: he had bands with different sets of buckets, adapted to the size of peas, of turnip seed, &c. I have used this machine for sowing benni-seed also, and propose to have a band of buckets for drilling Indian corn, and another for wheat. Is it possible that in doing this I shall infringe Mr. Evans' patent? That I can be debarred of any use to which I might have applied my drill when I bought it, by a patent issued after I bought it?

These verbal descriptions applying so exactly to Mr. Evans' Elevators, and the drawings exhibited to the eye, flash conviction both on reason and the senses that there is nothing new in these elevators but their being strung together by a strap of leather. If this strap of leather be an invention entitling the inventor to a patent right, it can only extend to the strap, and the use of the string of buckets must remain free to be connected by chains, ropes, a strap of hempen girthing, or any other substance except leather; but indeed Mr. Martin had before used the strap of leather.

The screw of Archimedes is as ancient at least as the age of that mathematician, who died more than two thousand years ago. Diodorus Siculus speaks of it, lib. 1, page 21, and lib. 5, page 217, of Steven's edition of 1559, folio, and Vitruvius, X. 11. The cutting of its spiral worm into sections, for conveying flour or grain, seems to have been an invention of Mr. Evans, and to be a fair subject of a patent right, but it cannot take away from others the use of Archimedes' screw, with its perpetual spiral, for any purposes of which it is susceptible.

The Hopperboy is an useful machine, and as far as I know original.

It has been pretended by some (and in England especially) that inventors have a natural and exclusive right to their inventions; and not merely for their own lives, but inheritable to their heirs; and while it is a moot question, whether the origin of any kind of property is derived from nature at all, it would be singular to admit a natural and even an hereditary right to inventions. It is agreed by those who have seriously considered the sub-

ject, that no individual has, of natural right, a separate property in an acre of land; for instance, by an universal law, indeed, whatever, whether fixed or movable, belongs to all men equally and in common, is the property for the moment of him who occupies it; but when he relinquishes the occupation the property goes with it. Stable ownership is the gift of social law, and is given late in the progress of society: it would be curious then if an idea, the fugitive fermentation of an individual brain, could of natural right be claimed in exclusive and stable property. If nature has made any one thing less susceptible than all others of exclusive property, it is the action of the thinking power called an idea; which an individual may exclusively possess as long as he keeps it to himself, but the moment it is divulged, it forces itself into the possession of every one, and the receiver cannot dispossess himself of it. Its peculiar character too is that no one possesses the less because every other possesses the whole of it. He who receives an idea from me receives instruction himself without lessening mine; as he who lights his taper at mine receives light without darkening me. That ideas should freely spread from one to another over the globe for the moral and mutual instruction of man and improvement of his condition, seems to have been peculiarly and benevolently designed by nature when she made them, like fire, expansible over all space, without lessening their density in any point; and like the air in which we breathe, move, and have our physical being, incapable of confinement or exclusive appropriation. Inventions then cannot in nature be a subject of property. Society may give an exclusive right to the profits arising from them as an encouragement to men to pursue ideas which may produce utility. But this may or may not be done according to the will and convenience of the society, without claim or complaint from any body. Accordingly it is a fact, as far as I am informed, that England was, until we copied her, the only country on earth which ever, by a general law, gave a legal right to the exclusive use of an idea. In some other countries it is sometimes done in a great case and by a special and personal act; but generally speaking other nations have thought that these monopolies produce more embarrassment than advantage to society; and it may be observed that the nations which refuse monopolies of inventions are as fruitful as England in new and useful devices.

Considering the exclusive right to invention as given, not of natural right but for the benefit of society, I know well the difficulty of drawing a line between the things which are worth to the public the embarrassment of an exclusive patent and those which are not. As a member of the patent board for several years, while the law authorised a board to grant or refuse patents, I saw with what slow progress a system of general rules could be matured. Some however were established by that board. One of these was, that a machine of which we were possessed, might be applied by every man to any use of which it is susceptible, and that this right ought not to be taken from him and given to a monopolist, because he first, perhaps, had occasion so to apply it. Thus a screw for crushing plaster might be employed for crushing corn cobs; and a chain pump for raising water might be used for raising wheat—this being merely a change of application.—Another rule was, that a change of material, should not give title to a patent; as the making a plough share of cast rather than wrought iron; a comb of iron instead of horn or of ivory; or the connecting of buckets by a band

of-leather rather than of hemp or iron. A third was, that a mere change of form, should give no right to a patent; as a high quartered shoe instead of a low one, a round hat instead of a three square, or a square bucket instead of a round one; but for this rule, all the changes of fashion in dress, would have been under the tax of patentees. These were among the rules which the uniform decisions of the board had already established: and under each of them Mr. Evans' patent would have been refused. 1st, because it was a mere change of application of the chain pump from raising water, to raise wheat. 2d, Because the using a leathern instead of a hempen band, was a mere change of material: and 3dly, square buckets instead of round, are only a change of form; and the ancient forms too, appear to have been indifferently square or round. But there were still abundance of cases which could not be brought under rule until they should have presented themselves under all their aspects; and these investigations occupying more time of the members of the board, than they could spare from higher duties, the whole was turned over to the judiciary, to be matured in a system under which every one might know when his actions were safe and lawful. Instead of refusing a patent in the first instance, as the board was authorized to do, the patent now issues of course subject to be declared void on such principles as should be established by the courts of law. This business however is but little analogous to their course of reading, since we might in vain turn over all the lubberly volumes of the law, to find a single ray which would lighten the path of the mechanic or mathematician; it is more within the information of a board of academical professors, and a previous refusal of a patent would better guard our citizens against harrassment by law suits. But England had given it to her judges, and the usual predominancy of her example carried it to ours.

It happened that I had myself a mill built in the interval between Mr. Evan's first and second patents. I was living in Washington, and left the construction of the mill entirely to the mill-wright. I did not even know he had erected elevators, conveyors and hopperboys, until I learnt it by an application, from Mr. Evans' agent for the patent price. Although I had no idea he had a right to it by law (for no judicial decision had then been given) yet I did not hesitate to remit to Mr. Evans the old and moderate patent price, which was what he then asked, from a wish to encourage even the useful revival of ancient inventions. But I then expressed my opinion of the law, in a letter either to Mr. Evans or to his agent.

I have thus, sir, at your request, given you the facts and ideas which occur to me on the subject. I have done it without reserve, although I have not the pleasure of knowing you personally. In thus frankly committing myself to you, I trust you will feel it as a point of honour and candour to make no use of my letter, which might bring disquietude on myself;\* and particularly I should be unwilling to be brought into any difference with Mr. Evans, whom, however, I believe to be too reasonable to take offence at an honest difference of opinion. I esteem him much, and sincerely wish him wealth and honour. I deem him a valuable citizen of uncommon ingenuity and usefulness; and had I not esteemed still more the establishment of sound principles, I should now have been silent. If any of the matter I have offered can promote that object, I have no objection to its being so used. If it offers nothing new, it will of course not be used at all.

\*It is proper to observe, that though the author did not at the time of writing this letter, contemplate its publication, yet his permission has since been obtained.

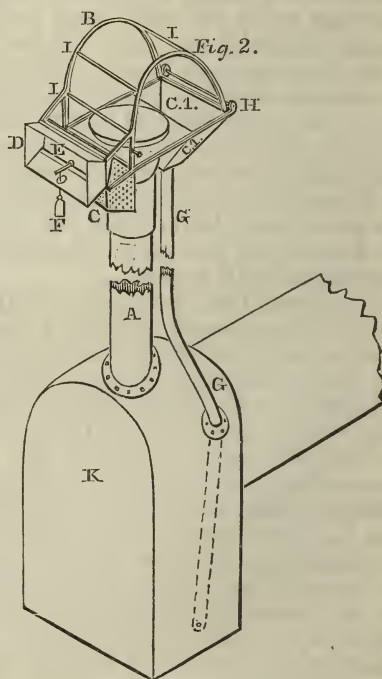
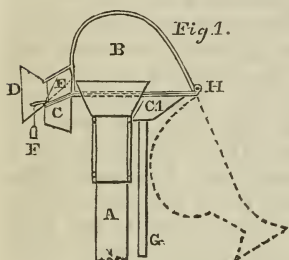
I have gone with some minuteness into the mathematical history of the elevator, because it belongs to a branch of science, in which, as I have before observed, it is not incumbent on lawyers to be learned; and it is possible, therefore, that some of the proofs I have quoted, may have escaped on their former arguments.

On the law of the subject I should not have touched, because more familiar to those who have already discussed it, but I wished to state my own view of it merely in justification of myself; my name and approbation being subscribed to the act. With these explanations accept the assurances of my respect.

THOMAS JEFFERSON.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Description of the Patent Spark Arrester, for Locomotive Engines using Wood.* By A. C. JONES, Engineer.



- A, the smoke pipe.
- B, cap.
- C C, receptacle for sparks, or cinders.
- D, funnel.
- E, valve or shutter; the dotted lines show it open.
- F, counterbalance to shutter.
- G, pipe to convey the sparks to the bottom of smoke chamber.
- H, hinges to admit of the cap being turned over, as shown in fig. 1.
- I, cross bars.
- K, smoke chamber.
- L, pin to turn the cap.

The advantages of the above represented cap over others that have been tried, are as follows: By making the front open, cold air is forced in by the speed of the engine; this, mixing with the smoke and vapour, cools it, and thereby prevents the gauze from being burnt; (on one engine the gauze has been in use nine months, and remains good at the present time.) The sparks and cinders being conveyed by the pipe, G, to the bottom of the smoke chamber, out of the influence of the flues, are there consumed; there is consequently, no trouble in cleaning the cap on the journey. By making the cap with hinge joints, the clogging of the gauze by lamp-black is prevented, it not being necessary to turn the cap over the pipe, until the train is ready to start. The facility with which the cap can be taken off, for the purpose of

cleaning, or to repair, is of some importance. In running backwards, the movable shutter closes the opening in front, and the sparks pass into the perforated box, and are consumed.

When the cap is in use, it is held down by a catch, which is released when the cap is to be turned off, as represented by the dotted lines, fig. 1.

The wire gauze is secured in its place by being clamped between the ribs of iron, and the frame.

After the experience of more than nine months with this plan of spark arrester, on three different constructions of locomotive engines, (and all with the same success,) I do not hesitate to say that the draught is not injured by the use of the cap.

#### *Certificates.*

Mr. A. C. Jones' spark arrester has been in use on the Portsmouth and Roanoke Rail-road, for about two months. It answers the purpose for which it was intended, and which its name indicates, better than any thing of the kind which I have seen. Since the use of Mr. Jones' machine, passengers are not at all annoyed by sparks, and a very slight covering is sufficient protection to the most combustible material (cotton in bales) which is transported on the road.

WALTER GWYNN, *Civil Engineer.*

I fully concur with Mr. Gwynn in recommending the invention of Mr. Jones, as the best which I have seen, and least likely to affect unfavourably the draught of the furnace of the engine.

ARTHUR EMERSON,

*President of the Portsmouth and Roanoke Rail-road Co.*

*Portsmouth, October 17, 1835.*

Communications relating to the spark arrester, (post paid,) directed to Thomas C. Garrison, or A. C. Jones, Portsmouth, Va., will be promptly attended to.

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## **Civil Engineering.**

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### *Report in relation to a proposed rail-road from the River Ohio to the Tide Waters of the Carolinas.*

The committee to whom was referred the subject of a rail-road from the Valley of the Ohio river to the maritime coast of the Carolinas and Georgia, having in a general manner considered its practicability and advantages, beg leave to submit the following

#### **REPORT.**

The states which border on the Ohio, or are watered by its great tributary streams, are western or tramontane Pennsylvania and Virginia, Ohio, Indiana, Illinois, Kentucky, and Tennessee; nearly through the centre of which that river flows, almost parallel with the sea coast of the old southern states. From the seven states above mentioned, there are highways of communication with the ocean in but two directions—north-east, and south-west. The former, consisting of several distinct lines of river, canal, macadamized and rail-road communication, reaches the Atlantic ocean between

the west end of Long Island Sound and the mouth of the Chesapeake Bay—from New York to Norfolk—a distance, on a straight line, of 300 miles: The latter communicates with the Gulf of Mexico by the delta of the Mississippi. Between these two points of marine connection with the interior, is a coast nearly 3000 miles in extent, constituting the sea-board of southern Virginia, North and South Carolina, Georgia, Florida, Alabama, and Mississippi, with which the states in the Valley of the Ohio have no direct communication, even by means of a good post-road, so that the mail to the northern frontier of Georgia and the Carolinas, not three hundred miles distant from the banks of the Ohio, in a straight line, is actually sent by Washington City, on a route nearly four times as long. With that part of the southern coast which lies west of the peninsula of Florida, the Ohio states have ready intercourse, by the Mississippi river; but with the region east of that peninsula, they are destitute of all adequate means of commercial and social connection. Here then is a great *desideratum*, which can be supplied in no other manner than by the contemplated RAIL-ROAD.

Starting, perhaps from more than one point on the Ohio river, in the state of Kentucky, this road should stretch nearly south; and branching, when it enters the Carolinas and Georgia, to reach their tide-waters at several different places. Taking Cincinnati as a city intermediate between Maysville and Louisville, and Charleston as intermediate between Wilmington, in North Carolina, and Augusta, in Georgia, the road might be said, more especially, to connect Cincinnati and Charleston, and may for convenience in this report, take its length and designation from those cities. Starting from the former, or rather, from the opposite bank of the Ohio river, in Newport or Covington, it would traverse the state of Kentucky to the Cumberland Gap, near the south-western angle of the state of Virginia, then cross the state of Tennessee, and, ascending the valley of the French Broad, in North Carolina, arrive at Greenville, or some other point, in South Carolina, beyond the Allegheny mountains, whence it may pass down to Augusta, in Georgia, by one branch, and by another more immediately to Charleston, in the direction of Columbia. In traversing North Carolina, it might with facility, the surface of the country permitting, be connected by a lateral road, with the projected Cape Fear and Yadkin rail-way, which passing through Fayetteville, is to terminate at Beaty's Ford, on the Catawba river.

The distance between Cincinnati and Charleston, on a straight line, is about 500, which would probably require a road of 700 miles. South Carolina, however, has already made a railway, 135 miles in length, to Hamburgh, on the Savannah river, opposite Augusta, nearly in the direction of Cincinnati; and the contemplated rail-road to Paris, in Bourbon county, Kentucky, exactly in the course of Charleston, (for the construction of which there are, in the opinion of your committee, a great many weighty reasons of a local nature,) would have a length of about 90 miles, thus leaving but 475 miles to complete this new and most important communication, between the interior and the sea-board of the south.

The middle of this main trunk would be intersected by the projected rail-road from Richmond, Virginia, *via* Lynchburg, to Knoxville, in east Tennessee, by which the Old Dominion would acquire a new channel of intercourse with her daughter Kentucky; and also with several of the states formed out of the North-Western Territory, which was once her property,—travelling from the West to southern Virginia, being thus restored to the route which it took in the infancy of our settlements.

By an extension west, to Nashville, of the Richmond, Lynchburg and

Knoxville road, the whole of central and northern Tennessee would be enabled, with great facility, to communicate with the Carolinas and Georgia, by means of the southern extremity, and with the state of Ohio, by means of the northern extremity of the great highway under consideration.

From the maritime terminations, and the lateral branches of this extended trunk, let us turn our attention to the northern or continental connections which it would establish.

These would extend, both east and west, from Cincinnati, for several hundred miles, and through every intervening northern point. First, the Ohio river would connect it with western Virginia and western Pennsylvania—embracing the valleys of the Great Kenhawa, Monongahela and Allegheny rivers: Second, the Ohio and Erie canal, from Portsmouth to Cleveland, already finished; the Miami and Maumee canal, in progress from Cincinnati to Lake Erie, uniting at Fort Wayne with the Erie and Wabash canal of Indiana; and the Mad-river and Sandusky rail-road, from Dayton to the Lake, the execution of which has commenced, would connect it with the entire chain of northern lakes, from the falls of Niagara to the Straits of Mackinac, and even Green Bay, on the western shore of Lake Michigan, including the eastern border of Wisconsin Territory, north or maritime Illinois and Indiana, the whole of Michigan Territory, a part of Upper Canada, and the centre and northern declivity of Ohio: Third, the Wabash and Erie canal just mentioned, and the rail road from Lawrenceburg, at the mouth of the Great Miami, to Indianapolis, already begun, would carry its advantages into the depths of Indiana: Fourth, the Ohio river from Cincinnati to the Mississippi would connect it, beneficially, with south and west Illinois, Missouri, and the immense extent of unsettled territory watered by the upper Mississippi and Missouri rivers. Thus the proposed main trunk, from Cincinnati to Charleston, would resemble an immense horizontal tree extending its roots through, or into, ten states, and a vast expanse of uninhabited territory, in the northern interior of the Union, while its branches would wind through half as many populous states on the southern sea-board.

The extent of this inland communication from north to south, through the centre of the United States, would comprehend at least 15° of latitude, and could only be compared with that established by the Mississippi river. It would not indeed be limited by the continent, for, as many important islands of the West Indies are contiguous to South Carolina, *they* would, in fact, be comprehended in the new facilities of intercourse that would be established between the south and north, and should, therefore, be taken into the estimate.

Of the physical practicability of constructing the main trunk of the proposed rail-way, across the states of Kentucky, Tennessee, and North Carolina, your committee see no reason to entertain a doubt. It is true, that it must traverse many of the branches of the Cumberland and Tennessee rivers, and scale the southern extremities of the Allegheny mountains. One of the branches, however, of the latter river, the French Broad, as we have already seen, originating on the slopes of the Blue Ridge, the most southern of the mountain chains, runs to the north, traversing the western angle of North Carolina, to unite with the Tennessee, thus opening a pass through a part of the mountains, and inviting to the enterprise. Of the height of the remaining mountains, your committee cannot speak with confidence, but believe it to be less than that of the Alleghenies, where they are traversed by the rail-road and canals from Philadelphia to Pittsburg. However this may be, no decision of the question of physical practicability

can be made, but by competent engineers, on an actual examination of the route.

The question of expense can of course only be settled by the same means. Assuming that the projected rail-road from the Ohio river, opposite Cincinnati, to Paris, in Bourbon county, Kentucky, will, from the considerations limited to the region of country concerned, be most certainly executed, and referring to the actual completion of the rail-road from Charleston to Augusta, the intervening section would not, as we have seen, exceed 475 miles, which, at the high price of 12,500 dollars per mile, would amount to 6,000,000 of dollars; a sum not greater than is about to be expended by a company of capitalists, in the construction of a rail-way within the state of New York, to run nearly parallel with her grand canal, and connect the same waters with the same city.

It may be said, however, that the central part of the Cincinnati and Charleston road would run through a country but thinly inhabited, and furnishing little aid, either in the construction of the road or in swelling the amount of transportation upon it. But why is it so sparsely peopled? Manifestly, in part, because of all portions of our common country, it is the most inaccessible and the most destitute of facilities for the exportation of its iron, salt, coal, tar, turpentine, and other natural productions. To wait, therefore, for a denser population, as a condition for commencing a great work of internal improvement, which only can augment that density, would be to wait for the development of an effect, before resorting to the only cause that can produce it. Let the road be executed, and an instantaneous impulse will be given to improvement in that region. If, however, it were too sterile for such a result to occur, no argument against the project could arise from that fact, for the undertaking is necessary to the reciprocal exchange of the production of the states penetrated by its extremities, in which respect it would be similar to the Philadelphia and Pittsburg route, which, in a part of its course, passes over uninhabited mountains, and still facilitates an immense trade between the east and west.

Thus it is not necessary that the whole line of an artificial way should lie through a cultivated and populous country, nor need we look to the inhabitants along this or any other projected rail-road or canal, for the means of its construction. These will be furnished by the capitalists of any and every part of the country, or even by those of Europe, the moment the enterprize is authorized by the states through which it is to be carried on, and the probabilities of a profitable investment are rendered manifest. In the opinion of your committee, the states of Kentucky, Tennessee, and the Carolinas, might, in their sovereign capacity, execute this work, and make it a rich and lasting source of revenue; and, they have as little doubt, that the incorporated joint stock companies would at once be able to command the requisite capital.

Your committee are of opinion, that the strongest motives exist for the immediate execution of this great work. At least half the people of the Union, comprehending, in whole or in part, in East Florida, Georgia, South Carolina, North Carolina, Virginia, Pennsylvania, Tennessee, Ohio, Michigan, Indiana, Illinois and Missouri, are interested in its completion, as they would instantly participate in its advantages; and, as your committee believe, need only to investigate the subject, to be at once aroused to efficient action.

Would it pass, like the New York canal, or the projected rail-road from Augusta, in Georgia, to Memphis, in Tennessee, nearly from east to west, and consequently combine regions which have similar climates, and identical

productions, its value would be far less. But, as we have seen, stretching boldly from north to south, and, with the present and future public works of the states between the Ohio river and the lakes, establishing a high road of communication through nearly all the climates and varieties of soil, productions, and people of the United States, it would forever stand alone and conspicuous among the public works of the Union, both in the kind and amount of commercial and social intercourse which it would promote.

The sustenance and manufactures of the corn states, from Kentucky to Michigan, would instantly pass along it to the southern consumer, of the region from Cape Florida to the Chesapeake Bay, avoiding all the delays, commissions, dangers of the river, and dangers and damages of a tropical sea voyage which belong to the Mississippi and Gulf route; and even much of the produce that might be designed for coasting or foreign exportation, would reach the sea-ports of South Carolina and Georgia, by the same channel, instead of going to New Orleans or New York. On the other hand, the tropical productions of the north-east of Cuba, and of East Florida—their spices, sugar, oranges, lemons, and figs;—and the indigo, rice and cotton of Georgia and Carolina would, by the same direct route, penetrate, in a few days, the interior of the continent, and spread among the consumers, even to the shores of Lake Superior.

Some of your committee, indeed, incline to the belief, that the same channel would, at no distant time, become an inlet for many of the productions and manufactures of foreign countries; for commerce, as far as possible, should be based upon a *direct* exchange of productions and commodities. Thus the shipping merchants of Charleston and Savannah, might barter their cotton in Europe for manufactures required by the people of the states in the Valley of the Ohio, and exchange the same for their sustenance; the whole operation, both continental and marine, being performed without the instrumentality of any other money than that employed in defraying the expenses of transportation.

Of the *amount* of the business that would, at length, be conducted on this national high-way, the committee scarcely dare to speak. To them it appears of a magnitude, which they fear the meeting and the community at the *present time* would regard as extravagant and incredible. By the existing population of the portions of country, even now connected with the work, there would be a great amount of traveling and transportation; but the extent to which it would augment the population of the zone of country through which it would pass; the impulse to agriculture it would impart; the manufacturing establishments it would set up, and the lateral turnpikes, rail roads and canals it would suggest, to new districts of country, from the western slopes of the Allegheny mountains to the banks of the Mississippi, from the sea to the lakes, would make it the parent of a great system of central internal improvement, and enable it to augment the amount of its articles of transportation to an indefinite degree. These immense pecuniary benefits, accruing to millions of people, should, of themselves, prompt those who are interested to an immediate attention to the work; but there are other and nobler considerations, which should not be overlooked.

No public work could contribute more powerfully to our national defence. Establishing a direct and rapid communication, between the northern and southern frontiers of the United States, separated, unlike the eastern and western, from the dominions of foreign nations by narrow sheets of water only, it would afford facilities for the transportation of troops, munitions of war, and military sustenance, from the centre to the borders, or even from one frontier to the other, with unexampled rapidity; thus favour-

ing a concentration, requisite to national defence in time of war, which could not otherwise be effected; and which would present a new triumph of civilization over barbarism, by making civil public works, an efficient substitute for standing armies and powerful navies, which exhaust the resources and endanger the liberties of a nation.

But the most interesting and affecting consequence that would flow from the execution of this enterprise, would be the social and political.

What is now the amount of personal intercourse between the millions of American fellow citizens of North Carolina, South Carolina, and Georgia, on the one hand, and Kentucky, Ohio, Indiana, and Illinois, on the other? Do they not live and die in ignorance of each other; and, perhaps, with wrong opinions and prejudices, which the intercourse of a few years would annihilate forever? Should this work be executed, the personal communication between the north and south would instantly become unprecedented in the United States. Louisville and Augusta would be brought into social intercourse; Cincinnati and Charleston be neighbours; and parties of pleasure start from the banks of the Savannah for those of the Ohio river. The people of the two great valleys would, in the summer, meet in the intervening mountain region of North Carolina and Tennessee, one of the most delightful climates in the United States; exchange their opinions, compare their sentiments, and blend their feelings—the north and the south would, in fact, shake hands with each other, yield up their social and political hostility, pledge themselves to common national interests, and part as friends and brethren.

Finally, the immense summer throng of visitors which annually go up to the north, along the sea-board, would be made still greater, and turning westwardly through the states of Virginia, Maryland, Pennsylvania, and New York, spread over the northern centre of the United States, to the shores of the lakes and upper Mississippi; concentrating on their return in the Valley of the Ohio; having seen what they now never see, and made acquaintance with what at present is unknown to them, the very heart of the Republic. On the other hand, the people of the north would, in autumn and winter, pour down upon the temperate plains of the south, in turn, studying their political, civil, and literary institutions, participating in their warm hospitality, catching a glow of southern feeling, gratifying their curiosity, and return enlarged in their patriotism and enriched in their knowledge of our common country. Thus this traveling, alone, would, at no distant day, reimburse the expenditures by which it might be created, while it would unite with the ties of business, in confining with a new girdle, states which are now but loosely connected, and thereby contribute powerfully to the perpetuity and happiness of the Union.

DANL. DRAKE,  
T. W. BAKEWELL, } Committee.  
JNO. S. WILLIAMS, }

*Cincinnati, Aug. 15, 1835.*

## Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Historical notice of a Hypothesis to explain the greater quantity of rain which falls at the surface of the ground than above it. By A. D. BACHE, Prof. of Nat. Philos. and Chem. Univ. Penn.*

In the report of Prof. Phillips, of King's College, London, on the relative

quantities of rain collected at different heights, the following hypothesis is offered, as deduced from his observations.

"So remarkable and continued an accordance between the co-efficients fixed by observation and those derived by two methods from a very simple view of the condition of the air as to heat and moisture, appears to me decisive of the question as to the general cause of the variation of the quantity of diminution of rain at any one height above the ground. It has already been shown how strictly the observations warrant the conclusion that the ratio of diminution at different heights is constant throughout the whole year. It is therefore rather as a matter of very probable inference than a plausible speculation that I offer the hypothesis, that the whole difference in the quantity of rain, at different heights above the surface of the neighbouring ground, is caused by the continued augmentation of each drop of rain from the commencement to the end of its descent, as it traverses successively the humid strata of air at a temperature so much lower than that of the surrounding medium, as to cause the deposition of moisture upon its surface." [Third Report of British Assoc. page 410.]

The fact that a less quantity of rain is received by a rain guage upon an elevation than upon the subjacent ground, was proved about the year 1766 by the experiments of Dr. Heberden, Lord Cavendish, and others. The hypothesis now advanced by Prof. Phillips, was suggested about 1771 as an explanation of their curious results by Dr. Franklin, and he is not the less entitled to the credit of originating it that after fully considering the subject he cautiously concluded, that the then state of knowledge of it was hardly ripe for making *any hypothesis*. "I think we want more and a greater variety of experiments in different circumstances, to enable us to form a thoroughly satisfactory hypothesis." His remarks contained in a letter to Dr. Percival, who has also written on the subject, were first published in the Manchester Memoirs for 1784. The following is Dr. Franklin's view of the matter:

"I suppose it will be generally allowed, on a little consideration of the subject, that scarce any drop of water was, when it began to fall from the clouds, of a magnitude equal to that it has acquired, when it arrives at the earth; the same of the several pieces of hail; because they are often so large and so weighty, that we cannot conceive a possibility of their being suspended in the air, and remaining at rest there, for any time, how small soever; nor do we conceive any means of forming them so large, before they set out to fall. It seems then, that each beginning drop, and particle of hail, receives continued addition in its progress downwards. This may be in several ways; by the union of numbers in their course, so that what was at first only descending mist becomes a shower; or by each particle, in its descent through air that contains a great quantity of dissolved water, striking against, attaching to itself and carrying down with it such particles of that dissolved water, as happen to be in its way; or attracting to itself such as do not lie directly in its course by its different state, with regard either to common or electric fire, or by all these causes united.

"In the first case, by the uniting of numbers, larger drops might be made, but the quantity falling in the same place would be the same at all heights; unless, as you mention, the whole should be contracted in falling, the lines described by all the drops converging, so that what set out to fall from a cloud of many thousand acres, should reach the earth in perhaps a third of that extent, of which I somewhat doubt. In the other cases we have two experiments.

"1. A dry glass bottle filled with very cold water, in a warm day, will pre-

sently collect from the seemingly dry air that surrounds it a quantity of water, that shall cover its surface and run down its sides, which perhaps is done by the power wherewith the cold water attracts the fluid, common fire, that had been united with the dissolved water in the air, and drawing the fire through the glass into itself, leaves the water on the outside.

"2. An electrified body left in a room for some time will be more covered with dust than other bodies in the same room not electrified, which dust seems to be attracted from the circumambient air.

"Now we know that the rain, even in our hottest days, comes from a very cold region. Its falling sometimes in the form of ice, shows this clearly; and perhaps even the rain is snow or ice when it first moves downwards, though thawed in falling: and we know that the drops of rain are often electrified: but those causes of addition to each drop of water, or piece of hail, one would think could not long continue to produce the same effect; since the air, through which the drops fall, must soon be stripped of its previously dissolved water, so as to be no longer capable of augmenting them. Indeed very heavy showers, of either, are never of long continuance, but moderate rains often continue so long as to puzzle this hypothesis; so that upon the whole, I think, as I intimated before, that we are yet hardly ripe for making one."

In investigating a complex subject of this kind, the experimenter not unfrequently proceeds as if it were entirely new, and to this cause I attribute the fact that Prof. Phillips was not aware that he had been anticipated in his hypothesis. The demonstration of the hypothesis, if it is considered conclusive is sufficient distinction, and belongs to a more advanced state of science than that of which the eighteenth century could boast. The credit of *originating it* we should abandon.

December, 1835.

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### *Notice of Tide Observations in the United States. By a Correspondent.*

TO THE COMMITTEE ON PUBLICATIONS.

In the American Almanac for the year 1836, of which there is a very favourable and just notice in the January number of the Journal of the Institute, occurs the following paragraph, from the pen of the editor of the astronomical department.

"It may be proper to remark that notwithstanding the three corrections above-mentioned, the computed time of high water frequently in calm weather, differs considerably, perhaps half an hour, from the computed. Indeed, until recently, astronomers seem to have been contented with the knowledge that the flow and ebb of the sea were caused by the attraction of the sun and moon, and to have taken little pains to increase their acquaintance with these curious and interesting phenomena. But as, within a short time, much attention has been turned to the subject, and many competent persons in Europe have undertaken to make careful observations for a series of years, on every tide, we are induced to hope that the causes of some of the anomalies, not only in the time of high water, but also in the rise of the tide, may be discovered, and their effects predicted. It is a source of deep regret that these European savans will not, probably, find any co-labourer in this country. Possessed, as we are, of an immense coast, and the second commercial nation on earth, it would seem that an accurate knowledge of the causes of the tides would be, unto us, of the highest importance; but there is too much reason to fear we shall do no more to advance this great work, than we have done for astronomy in general, viz: to declare ourselves the most enlightened people ever in existence, to fold our arms, and continue to be indebted to the noble nation from which we are descended, for their Nautical Almanac, without which, hardly an American vessel would go to sea."

Now, here is a severe charge by an American editor, which ought only to have been made, if made at all in such a work, after full inquiry into the

facts of the case. "There is too much reason to fear that we shall do no more to advance this great work, than we have done for astronomy in general." Whatever reproach must lie at our door for the neglect of astronomy in general, we are blameless in regard to the branch relating particularly to the tides, at least as far as observation goes. Inquiry would have shown that an extensive series of tide observations were made along the line of our Atlantic coast, in June last, under the direction of the commander-in-chief of the United States' army, and by request made to the Executive of the United States, by a branch of the government of Great Britain. We ought, perhaps, before this, to have had in some one of our journals at least a general account of these observations. The execution of the task without any accompanying boast will serve, however, to illustrate the disinterestedness of the motive which prompted the undertaking, while the nature of the undertaking itself vouches for some share of scientific zeal.

An acknowledgment for these promised observations was made by the Rev. Mr. Whewell, at the meeting of the British Association for the Advancement of Science, in August last. D.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Review of a "Geological Report of an Examination, made in 1834, of the Elevated Country between the Missouri and Red rivers. By G. W. Featherstonhaugh, U. S. Geologist.\* Published by order of both Houses of Congress. Washington: Printed by Gales & Seaton. 1835."*

In the present age of utilitarianism, the value of scientific knowledge is very generally and very properly appreciated, by the benefits which result from its practical application to the ordinary pursuits of life; and there is no science which, when tried by this test, ranks higher in the scale of utility than geology. Its existence is, indeed, of recent date, but it has already afforded more real and useful information respecting the structure of the planet we inhabit, and the position of its mineral treasures, than had been acquired in all the previous ages of the existence of the human race. It was, therefore, to be expected, that both governments and individuals would be eager to avail themselves of the facilities presented by this science, and to apply them to the investigation of those subterranean sources of wealth, which are so influential in the promotion of national prosperity. The spirit of enterprise, so characteristic of the American people, was promptly directed to so attractive an object; and different geological surveys have been made, the results of which have been in the highest degree beneficial to the interests of the country. The state of North Carolina may be said to have taken the lead in this career of utility; and the zeal of Massachusetts in the same cause has been rendered eminently conspicuous by the full and able report of her geologist, Prof. Hitchcock. These examples have been followed by the general government, and those of the states of New Jersey, Virginia, Maryland, and Tennessee. Different gentlemen have been employed by these authorities to make geological investigations of states, or districts, and several of their reports have been made and published; some portion, therefore, of information on this important subject, has been very generally diffused. It must not, however, be concealed

\* Whence this title is derived, or by whom conferred, we are uninformed. Geological surveys have been made in England, and in France, but we have never met with the title of "Geologist of England," or "Geologist of France."

that there is some danger of our being led into error by these attempts to circulate knowledge; for, unless the persons selected to make these surveys are eminently qualified for the task, and discharge it with judgment and caution, erroneous opinions may be promulgated, and results proportionably disastrous will be the consequence; for, as the statements thus made are brought forward under the stamp of a certain degree of personal and official authority, they may, perhaps, frequently obtain more credit than is due to their intrinsic merit.

I have been led to these considerations by the perusal of the report lately made to the general government by Mr. Featherstonhaugh, the gentleman employed by it to make geological researches in some of its territories, upon which I purpose to offer some brief remarks. In the copy of the instructions of the Topographical Bureau, prefixed by Mr. F. to his report, we find that he was directed "personally to inspect the mineralogical and geological character of the highlands and water sheds, in the elevated country lying between the Missouri and Red rivers, where the public lands are situated," and to state whatever geological information he might possess, which might aid in developing the resources of said country." Under the authority, probably, of the requisition contained in the latter part of these instructions, or, as he himself states, to make his report as permanently instructive as possible, and *transparent to the intelligence of all*, (see p. 6 of the report,) he has thought proper to commence it with a geological essay, which occupies about one-half of the work. The propriety, in any case, of thus swelling out a report, is very questionable, for it distracts the attention from the main object of the work, and, unless it is exceedingly well executed, it does not communicate either instruction or information to the parties whom it is intended to profit. Professor Hitchcock had indeed set the example, in his report on the geology of Massachusetts; but it may be doubted whether, by so doing, he has not sacrificed what ought to have been the main object of his undertaking, viz: the communication to the great body of the people of his state, in language so free from technicalities as to be generally intelligible, a plain statement of its resources and mineral wealth. This error, however, if it be one, is, in a great measure, compensated for by the character of the report itself, which may vie with any geological work extant, in the accuracy of its scientific details, and the fidelity of their topical application. The same cannot, I think, be said of the essay of the U. S. Geologist, which is not only somewhat unsatisfactory in its matter, but also very generally expressed in language, which, so far from being *transparent to the intelligence* of the uninitiated, must, in a great measure, be unintelligible, even to those who are more intimately acquainted with the subject.

It would be an ungrateful and invidious task to point out all the passages in this work which seem liable to these objections; I must, however, in justification of the opinions I have ventured to express, offer one or two instances. I would therefore ask what meaning is to be elicited from the following passage: "We are not to regard the radial space as a mere vacancy, where igneous action is exerted, but as a field where it acts upon matter in states and conditions of which, perhaps, the scientific chemist has but a faint conception; for we are taught, upon the authority of eminent philosophers, that the density of the interior is much greater than that of the crust. It will be perceived by this mode of reasoning, that the force of such a radial space, acting under such conditions, could not but produce results equivalent to the grandeur of its power, and which might justify geologists in referring the origin and actual state of what is called the crust

of the earth, to its direct and indirect action." (p. 8 of the report.) I believe that, on the principle of taking "*ignotum omne pro magnifico*,"\* the grandiloquent obscurity of these sentences, which are taken at random, and to which parallels are to be found in almost every page, has not a little contributed to obtain for this report, amongst certain persons, the celebrity which it seems to have acquired. To compensate, however, for the mysticism of the above quotation, in the next page the author favours us with a truism, which cannot fail to be particularly edifying to the European geologists, who, he says, are calling "upon us of this western continent for geological investigations;" for he seems actually to have discovered, that "if, at any period in the history of our planet, the mineral matter constituting the dry land has been distributed beneath the waters of the sea, the planet would then have been entirely covered by water."—(p. 9 of the report.) It was, perhaps, hardly necessary to have gone so far as Arkansas, to ascertain this fact. Mr. F. seems, also, to have discovered a new method of determining heights, to which he, on two or three occasions, refers; for instance, at p. 59, he says, "On extricating myself from this arid plain, I reached a ridge with an elevation of about 70°." It is to be hoped that, in his next work, he will favour us with the scale upon which his heights are graduated, for, as he does not refer to any horizontal base, and could not, in the situation which he is describing, command the horizon of the sea, there is at present some ambiguity in his expression.

Some explanation seems to be required, likewise, of his novel mode of estimating the measure of dimensions, for the problem, to find the "superficial cubic contents" (p. 52 of the report) of a body, is one with which we are not familiar.

But I will not dwell on these inaccuracies of language, as it is of more importance to examine the correctness of such of the statements of our geologist, as are more particularly connected with the objects of his tour; for, on the supposition that they may be received as authority, an error in them would be attended with more injurious results.

It may, perhaps, be considered, that he has traveled somewhat out of his record in communicating to us his opinions respecting the gold mines of this country; but as they are delivered with an air of confidence, likely to impose conviction of their truth on persons unacquainted with this subject, they may not be undeserving of remark; for all exaggerated estimates of the value, or probable duration, of these mines, have a tendency to lead to fruitless expenditure, and consequent disappointment.

Mr. Featherstonhaugh states that "Gold mining is yet in its infancy in the United States; in truth, preparations for systematic mining are only now making."—(note to p. 9 of the report.) Persons most conversant with the subject are, however, I believe, unanimous in the opinion, that it has at least reached its full maturity, if, indeed, it be not already past its prime. The only description of gold mines as yet worked with any profit in this country, are those termed deposit mines; and if we look at the present condition of the gold districts in North Carolina and Georgia, where this description of mine has been most extensively found, we shall see that this opinion is not without foundation. In all the counties of North Carolina, south of the mountains, the mines have been worked, and nearly exhausted; in Burke and Rutherford counties, particularly in the latter, where the discovery of mines is of most recent date, there still remain deposits, which, if worked with no greater force than that at present employed upon them, may last four or five years longer; and the portion of the Cherokee

\* Tacitus vit. Agric.

territory situated in the state of North Carolina, where it has been ascertained that gold may be found, and in which the mines have been but partially worked, is of very limited extent, and its mines are not considered, by persons who have examined them, to be so rich as those in that part of the territory lying in Georgia. The deposit mines of North Carolina will, therefore, be of finite duration, and the quantity of their produce may be expected to sink gradually under the decline which they have manifested for the last two years.

The deposit mines in Georgia have, probably, been richer than those in any other part of what is called "the gold country;" but the minute division of property in that portion of the state where they were most abundant, occasioned by the injurious system of lottery, under which it was parceled out amongst the good citizens of the state, and the high degree of excitement into which the public mind had been brought on the subject, occasioned extensive operations to be commenced simultaneously in all parts of the district, as soon as the right of property had been determined.

The extent of each gold lot was small, and the proprietors were eager to reap the golden harvest, by the prospect of which their expectations had been so strongly excited; the consequence of this was, that many of the mines, and some of them the best in the district, were worked out during the first year after the drawing of the lottery; but, so great was the number of adventurers who entered into this business, entirely ignorant of the first principles of mining, that it may be confidently affirmed that more money was lost than made, during that year, in the gold mines of Georgia.

This bad success greatly diminished the number of miners in the succeeding year, but, as those who persevered had acquired more judgment, and conducted their operations with greater skill, their labours were rewarded with better success, and the quantity of gold procured from the mines, during each of the two last years, has been as great as in the first year, and the profits of those engaged in the business more considerable. But this cannot last, and I have been recently informed by an intelligent gentleman, in whose opinion I have full confidence, that nearly all the deposit mines will certainly be exhausted in less than two years more. Some few persons, indeed, who, by their speculations during the drawing of the lottery, obtained possession of several lots, may have reserved localities on which operations may be continued for a longer period, and some of the mines in what are called the older counties, such as that of Mr. Richardson, in Habersham, being of larger extent, may have a proportionably longer duration; the beds of the Chestatee and Etowah rivers may likewise yield gold for a long time, but the annual supply from all these sources cannot be expected to be nearly so great as that which has been afforded during each of the last three years by the mines of this state. I have but little personal knowledge of the mines of Virginia, but by what I have learnt from the accounts of others, the deposit mines of that state have never been either numerous, or very productive. As, therefore, deposit mines are, from the very nature of their formation, and from the ease with which they may be worked, of short duration, in a country where the mining districts are of limited extent, and where the industry of a large population will always be directed to so alluring a pursuit, the hopes of this country for a continued supply of gold from its own resources, must ultimately rest on the vein mines, and it must be to these that Mr. F. alludes, when he says, "preparations for systematic mining are only now making." Now, I am sorry to differ with him in opinion, but I have seen many mines, of various

metals, and in different parts of the world, and I never saw one in which more skill and science were evinced in the construction of the works for the reduction of the ore, or in the underground works of the mine, than in the gold vein mine near Charlotte, in Mecklenberg county, N. C., owned by a company in New York, and conducted for nearly three years by the Chevalier Rivaolinoli, who was himself a scientific miner, and had under him officers, both natives and foreigners, of competent ability; yet the undertaking entirely failed, not from any want of system, or skill, but because the mine gave out, or became too poor to pay the cost of working. I could mention many other mines, both in North Carolina and Georgia, which at first gave great promise of success, and in which the works, though perhaps inferior to those at Charlotte, were constructed on principles recommended by European practice, but which have all failed from a similar cause. In consequence of these disappointments, vein mining for gold has been very generally abandoned, and I believe no other than the Capp's mine, near Charlotte, was in course of work at the close of 1834. As, during the last year, I have been less acquainted with the actual state of the mines than formerly, I do not know what may be the present prospects of the last mentioned mine, or whether any others have been opened in North Carolina, or Georgia; but the instances I have cited, sufficiently prove that the present low condition of vein mining in those states is rather owing to the poverty of the mines, and to their small extent in depth, than to the want of system, or industry, in their management. Mr. Featherstonhaugh says, "not one shaft has yet been sunk exceeding 160 feet;" a satisfactory reason to account for this is, that every mine, yet opened, has given out before it reached that depth. Several gold vein mines have likewise been discovered in Virginia, and the working of one in Fauquier county has been commenced by a company, which is proceeding with much spirit in the undertaking; it is to be hoped success will crown the efforts of its proprietors, but no reasonable conjecture can be formed as to their prospects, till they have reached the depth of from 100 to 150 feet.

These observations certainly militate against the conclusion, "that the progressive scale of production since 1824 warrants the most favourable anticipations for the future;" for, if they are correct, it may rather be expected that the produce of gold from the mines of this country has already reached its maximum, and is henceforward likely to decrease. According to a statement, which I saw a few days since, of the quantity received in the mint during the present year, 1835, it appears to be less than that received in 1834, by between twenty and thirty thousand pennyweights, and not to amount to more than one-fourth part of the three millions of dollars, predicted by Mr. F. as the produce of the year; and it must likewise be considered, that, in consequence of the advanced price given at the mint, under the new regulation of the value of gold, the proportion of the whole produce which now reaches that establishment, is likely to be greater than formerly.

In page 14 of the report, we find the following remark: "talcose slate" is a mineral formation, in which the auriferous veins of the United States are found, the veins in some parts of the country, passing through a field of talcose slate several miles in breadth, whilst in others they are sheathed only, as it were in the talcose slate, and pass through a field of elvan and granite rocks of various kinds." If by this assertion, it is intended to be implied that talcose slate is exclusively the repository of the gold veins in the United States, it is certainly at variance with general experience; that this formation is favourable

to the production of gold, and that veins of that metal are frequently found in it, will readily be admitted, the mines of Virginia and some of those in Georgia are thus situated, but nearly all those of North Carolina and most of those in Georgia are found in a very different rock: and no instance, I believe, of a gold vein in granite has ever presented itself in this or any other country; the small quantity of gold found in Cornwall has always been obtained from the formation, known in that country by the name of killas.

Our author appears to be a believer in the exploded doctrine, that the formation of metallic veins is attributable to the ejection of mineral matter in a state of igneous fusion from the interior of the earth; should the capitalists of Missouri be induced, by a confidence in "the reasonableness of the opinion that metallic veins have their origin from below," (p. 10) to enter with more spirit into the business of mining, it would undoubtedly be a benefit both to themselves and to their country; but should this be their only inducement, it may be feared, that they will be discouraged in the pursuit, when they discover that the most eminent geologists in this and other countries consider that such a mode of their formation is far from being satisfactorily established; if such however is the opinion of Mr. F. he certainly has a right to express it, but as it has been a controverted question, some reasons for such a belief, more conclusive than his arbitrary dictum, would perhaps have been desirable in a work intended to be "permanently instructive."

Mr. F. does indeed refer to some circumstances in a subsequent part of his work, which, he says, "seem to point to a projection of mineral and metallic matter from below:" but, if we examine these circumstances we shall not, I think, find in them, any thing like an argument to support this hypothesis. That the flat or horizontal veins which he met with in the lead mines of Missouri, are "lateral jets from the main lode," cannot be doubted; but the position of the metal at the bottom of the cavities or pockets which he describes, is most satisfactorily accounted for by the supposition that it has percolated, whilst in a state of fusion, through the soft matter of the red clay; for the admission, that it was brought into this situation by a projection from below, would be a contradiction of his own theory of their formation.

From various passages in the report, it is evident, that Mr. F. inclines to the opinion, that bituminous coal is a substance originating from mineral matter; this is another disputed point amongst geologists, and every one is at liberty to defend the side of the question which seems to himself most reasonable. It may however be observed, that the presence of "bituminous matter in beds of fetid limestone" has been satisfactorily accounted for on other grounds, and even admitting as fact the very questionable assertion, (p. 32) that the exclusive carboniferous country, in which coal is found to the west of the Mississippi, does not present a basin-like appearance, in which trees or plants could have been washed, or in which aquatic plants could have adequately grown, still it does not present any argument to disprove the opinion of those who attribute to coal a vegetable origin; for they generally suppose, that the vegetable growth, which produced the coal, was deposited on the spot, where it originally grew, and not that it has been washed into the situations where it is now found; and as the remains of vegetation distinguishable in coal beds, by no means indicate an exclusively aquatic growth, such a disposition might as easily have taken place on a level as on a basin-like surface.

Were I to instance all the glaring violations of philosophical principles and scientific language, which obtrude themselves upon our notice throughout this prefatory essay, I should trespass too largely on the pages of your

journal: I must therefore pass them by, and proceed to accompany our geologist on his tour, and as we journey on together, I hope he will allow me the privilege of making such observations, as may enable us duly to appreciate its "interesting results!"

It will be seen that he dashes at once "*in medias res*," and that, although he has presented the public with a map of unusual longitudinal dimensions, he leaves it to be inferred, from his own authority, that its geological delineations are correct, and does not offer any particular explanations of its contents. On his arrival in Missouri, his attention was necessarily directed to the lead mines, which form so prominent a feature in the mineralogical character of that country. These mines appear to lie unusually near the surface, and to be of such exuberant richness, that the main vein extends itself in lateral branches, or, as they are generally termed by miners, flat veins, in all directions, where the softness of the materials of the adjacent country, or natural fissures in the strata of the rocks, permit the formation of the metal. Such of these flat veins as lie nearest the surface, appear to have been broken into fragments, more or less minute, by some great convulsion occasioned probably by that modification of the power of volcanic agency, which so frequently displays itself in the production of earthquakes; a visitation to which the events of the year 1812 have shown this district to be liable; electrical action may likewise, as supposed by Mr. F. have contributed to the production of these effects.

These disruptions of the surface have exposed to view the contents of such of the upper veins, as from their situation were most affected by the shock, and, as a necessary consequence of such exposure of the mineral, adventurers have applied themselves to its extraction, by digging pits on the surface, and have thus brought the face of the country into the disorder described by Mr. F.; and which he attributes to ignorance of the geological structure of the country, and the commonest principles of mining. That such persons were not likely to be great proficient in the science of geology and oryctognosy must be allowed, but perhaps more information on these subjects would not have induced them to alter the mode of their proceedings; for they well knew, that the readiest mode of procuring the ore, was to them the most profitable; and as each individual had nothing more to do, than to dig a pit, and collect the metal it afforded; such a desultory method of working answered the purpose of supplying their immediate wants; and, as they were careless of consequences, they preferred it to entering into combinations with others, and commencing the more laborious and hazardous undertaking of deep mining. The same course has invariably been pursued, on the first discovery of surface mines in all parts of the world, till the right of property was established; in the earliest ages, the mines of Cornwall were thus worked, and, more lately, the gold mines of Georgia suffered from a similar cause, for it is exactly the mode in which the adventurers, or intruders as they were called, conducted their operations, till driven off by the guards of the State. It will be obvious to the intelligence of every scientific miner, that these superficial works, if in the vicinity of a main vein, will be productive of effects exceedingly injurious and embarrassing to any future attempts to work the mine in a more regular manner; and an immediate stop should be put to such proceedings if carried on upon the public lands; for the benefit of the individuals engaged in them, bears no proportion to the deterioration they occasion in the value of the property. The superficial indications of veins, situated as those above described, are necessarily numerous and easy to be understood; for as the gangue of the shatter-

ed veins is thrown out with the mineral, when rocks of a similar character are discovered on the surface in other places, it is good evidence of the proximity of a vein, in situations where the mineral may be concealed by the superincumbent soil. I should suppose, it must have been from such circumstances that Mr. F. has been enabled to determine, (p. 51) "that the mineral indications on the public lands were quite as encouraging as at the established mines" for he gives us no particular account of the means he took to ascertain the fact, indeed this brief assertion contains all the information, with which he favours us, respecting the mineralogical character of that portion of the public lands, which may be supposed to contain lead. It is much to be regretted that he did not consider it a part of his official duty to investigate more fully the character of the produce of the lead mines in Missouri, particularly in those places where shafts have been sunk to some depth; for he must have been aware that galena is very generally accompanied by sulphuret of silver, and he might have known, that the substance which forms the gangue of the mines he visited, is similar to that of the gangue of the celebrated mines of Clausthal, in the Hartz mountains in Hanover, which are richer in silver than any other mines in Europe. Such an enquiry would have been interesting both to scientific and practical men, and would have enabled the Government, and the country to form a more correct estimate of the value of the public lands in that state and the neighbouring territories. He does indeed mention in another part of his report (p. 61) "that he had never seen in any portion of the territory of Arkansas, the least indication of the precious metals, apart from a very small portion of silver contained in the sulphuret of lead;" but as he gives no account of any lead mines being worked in Arkansas, he must have formed his opinions on this subject, from the inspection of those fragments of sulphuret of lead, which he describes, as found on the surface, in furrows excavated by the rains; and if he could see in such specimens any trace of silver, he surely ought to have considered it as an evidence of much richer argentiferous ore at a greater depth; and to have been induced to examine with more attention the ore from the lowest veins in the shaft at Tapli's and Perry's mine. The next mineralogical object which he notices, and which he describes, (p. 51) as one of the "rarest natural metallic spectacles" he had ever seen, was what he calls a "veinlike mass of submagnetic iron;" this and some other similar beds of iron are upon the public lands, and he gives quite a rapturous description of the benefits to be derived from this discovery; his mode of estimating its value is not however expressed in "terms" quite so intelligible as might be wished. Neither is his description of the iron itself, such as renders it easy of recognition by the mineralogist; for "submagnetic iron" forms neither a species or subspecies in any system of mineralogy, with which we are acquainted: from the circumstance as mentioned in a note, of his suspecting it to contain an "excess of sulphur," it may probably be the magnetic pyrites of Cleaveland, but if so, it is not of much value as an ore. After having sufficiently admired this "extraordinary phenomenon," he proceeded from Missouri into Arkansas, first to Little Rock, and from thence to the Hot Springs of the Washita, and the description of this part of his tour is sufficiently interesting; the most important geological fact, which he mentions in it, is the singular tendency to silification so manifest in that, as well as many other parts of the western country. In the neighbourhood of the Washita Springs, he again met with a bed of iron (he was now provided with a pair of "natural metallic spectacles") which he describes as being magnetic, (a term which we can understand,) and of considerable extent; the situation

in which it is found is remarkable, being an elevated cove or basin-like cavity, based upon greenstone, and surrounded by a circular brim of the same rock. His opinion, that the elevation of this greenstone rock is the result of volcanic action is novel, because we have I believe no instance of any of the trap rocks, having ever assumed the conical form, characteristic of modern volcanic mountains, but it may nevertheless be correct.

(TO BE CONTINUED.)

## Franklin Institute.

### *Monthly Conversation Meeting.*

The monthly meeting for December was held at the Hall of the Institute, Dec. 24, 1835.

Mr. Franklin Peale explained the construction of a press for milling coins, about to be introduced by him into the U. S. Mint. The simplicity and efficiency of this machine were much admired. It is adapted to motion by steam power.

Mr. Scott, of Philadelphia, exhibited a fireproof chest, of his invention. The imperfect conductor, which encloses on both sides the wooden frame of the chest, is asbestos; this is protected without, by a stout coating of iron. Mr. Scott stated that one of his chests had been in the cellar of a store burned during the late disastrous conflagration in New York, and that the papers and notes within it were found unharmed, when the chest had been dug from the ruins.

Mr. J. Philbrick, of Natchez, Mississippi, illustrated, by a model, a patented invention for protecting cotton, &c., in the act of drying, from sudden showers. The invention will be submitted, for an opinion, to the Committee on Science and the Arts.

Prof. A. D. Bache, from the Committee on the Explosions of Steam Boilers, showed two cylinders, one of iron, the other of copper, which had been burst explosively, by a gradual increase of pressure. He gave an account of the experiments of the Committee on this subject.

Wood cuts, representing these cylinders, by Mr. R. S. Gilbert, were laid before the members, and were much admired.

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### COMMITTEE ON SCIENCE AND THE ARTS.

#### *Report on Messrs. Seymour and Whipple's Fire Alarm.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts to whom was referred for examination, an Alarm in case of Fire, &c., invented by Messrs. Bradford Seymour and Squire Whipple, of Utica, New York, REPORT:—

That the said alarm consists of a coiled spring of two different metals attached to the wall or threshold support, with one end extending out to form an index, moving a few degrees over the arc of a circle, and serving to move a small hammer, which, at ordinary temperatures, is set in a nearly vertical position against a pivot. But on the temperature being elevated to a given extent, which may be limited at pleasure, the index above mentioned, causes the hammer to fall and raise a sort of trigger, which allows a small weight suspended on the inside of an alarm clock, to descend and set in motion the alarm apparatus.

The inventors have mentioned the purpose of this thermometrical alarm to be to give notice of the occurrence of a fire in any apartment in a building, but the committee conceive that it may answer this and many other purposes, in which it may be desirable to be notified of the occurrence of a given elevation or depression of temperature. The apparatus is neat and even ornamental, and as it appears, to the committee, will answer perfectly the purpose intended by the inventors.\*

By order of the committee.

November 12th, 1835.

WILLIAM HAMILTON, *Actuary*.

### *Report on Philip Laibacker's Door Lock.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Door Lock, invented by Philip Laibacker, of Philadelphia, REPORT:

That they have examined the lock of Mr. Laibacker, the improvement in which was stated to consist in a contrivance to cover the key hole; to be used by a person inside, which prevented the introduction of any thing into the lock for the purpose of picking it from the outside.

The lock itself was a specimen of neat and substantial workmanship, of a kind which Mr. L. informed the committee, he had been in the habit of making in Europe; and the application of the safety valve must give it additional security. The manner of effecting this object is by fixing a small sliding plate upon the face of the lock-plate, which, after removing the key, on touching a button at the top of the lock, is shoved by a spring and completely covers the key hole.

The committee believe that the plan before them will fully answer the purpose of guarding and securing the key hole from all pick operations from the outside—but they do not perceive any great advantage it possesses over the common lock with a separate bolt, for supposing a hole to be made through the door to introduce the hand, it would be as easy to remove the cover from the key hole as to draw the bolt.

By order of the committee.

November 12, 1835.

WILLIAM HAMILTON, *Actuary*.

### *Report on Joseph Snyder's Parlour Grate.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Parlour Grate, invented by Mr. Joseph Snyder, of Philadelphia, REPORT:—

That this grate is more properly an open stove, constructed chiefly of cast iron, with a lining of fire clay, and is intended to stand upon the hearth within the apartment. The entablature is supported upon two sheet iron columns, through which the heated air passes from the base to the top of the fire-place. To produce a circulation of the gas and hot air (from the coal) throughout the structure, the flue in the head of the stove is divided horizontally into two compartments.

The lower division into which the gas first passes is connected with a flue descending behind the grate; this flue communicates by means of two hori-

\* See vol. xvi., p. 307. [Editor.]

zontal passages beneath the grate, with the bases of the sheet iron columns before noticed: these convey the gas into the upper division of the flue at the head of the grate, from which it passes into the chimney. By means of a sliding valve a communication may be opened between the two compartments of the upper flue, so that the gas can pass directly into the chimney without circulating through the fire place. There is another valve beneath the grate, by opening which the air of the apartment is permitted to circulate through the flues and check the draught of the grate.

The committee are unable to speak of the merits of this grate from experiment, as they have not seen it in operation. But from a simple inspection of it, they are inclined to the opinion that it will render available a much larger proportion of the heat of the fuel than is obtained from a grate set in the usual manner; but perhaps not so much as is afforded by a common coal stove. It is however better adapted to parlour use than a stove by its superior neatness and cheerfulness.

Respecting the novelty of this invention the committee will merely remark, that contrivances somewhat similar to this, for retaining the gas and heated air from the fuel within the apartment, have been in use for many years; and that to sustain a claim on this point, the inventor will be obliged to confine himself strictly to a particular form, and not attempt to claim the broad principle upon which its usefulness depends.\*

By order of the committee.

November 12, 1835.

WILLIAM HAMILTON, *Actuary.*

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## Mechanics' Register.

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### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1835.

*With Remarks and Exemplifications by the Editor.*

1. For a *Lathe for Cooper's Ware*; Isaac Hoover, Miamisburg, Montgomery county, Ohio, July 2.

This, so called, lathe consists of a horizontal platform upon which a barrel or cask, is to be placed and confined by proper dogs, or holdfasts; the platform is made to revolve by turning a winch with a bevil gear, and when the cask is in motion, the tools for champhering, crossing, leveling, &c., properly mounted for the purpose, are held against it. The only claim made is to "the increasing size and power to any extent."

In England and in France the manufacturing of cooper's ware by machinery has been carried to a great extent; but the first establishment of the kind, of which we have seen an account, was in Scotland. Much of the machinery patented here is similar to what has been used for the same purpose there; all the operations which could be performed by giving the vessels, the heads, &c., a rotary motion, have been so performed, and by means the same in substance as that above described.

2. For a *Stove for Cooking and Warming Rooms*; Ernst G. Augustine, city of New York, July 6.

We cannot discover what it is here intended to patent, but as some of our readers may be possessed of a more acute perception than ourselves, we will insert the whole of what is called the description.

\* See No. 16 of remarks, &c., page 43 in the present volume. [Editor.]

"This stove is made of cast iron in a pyramidal form; it consists of a furnace in which is burned wood or coal; an ash pit, over which are openings to receive a boiler on each side of the centre columns. In the centre is an opening in which roasting, frying, and baking, are to be performed; over this oven is an opening to receive another boiler. The steam from all these vessels is conveyed in a tube into the chimney and carried off without any inconvenience.

"The invention here claimed and desired to be secured by letters patent consists in the arrangement and adaptation of the several parts of the stove, by which cooking is performed, and the steam carried off, as before described."

Accompanying the specification is a drawing lithographed, and having between thirty and forty references, but these do not give any light as regards the claims of the patentee.

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3. For a *Machine for Cutting Straw*; Ernst G. Augustine, city of New York, July 6.

The claim under this patent is "to the use of a spring fixed below the cutting frame, and attached to it." The remarks upon the preceding specification and drawing apply fully to those now before us.

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4. For a mode of *making Shoes, and rendering them impervious to water*; Ernst G. Augustine, City of New York, July 6.

The soles we are told "may be made of plaited flax, hemp, or the inner bark of the linden tree. For the upper part any kind of cloth may be used, and the shoes lined with linen or cotton. The soles are then varnished or covered with the following composition:—one quart of flax-seed oil, two ounces of rosin, half an ounce of white vitriol, which must be boiled together for half an hour. After which take four ounces of spirits of turpentine, and two ounces of white oak saw-dust, which has been exposed twenty-four hours to the sun: mix these ingredients well together, and put them on the soles of the shoes with a brush or in any other way, which when dried will render them impervious to water."

The claim is to "the above described method of making shoes and rendering them water proof." We do not discover any method of "making shoes" contained in the foregoing description.

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5. For a *mode of making Vinegar*; Frederick W. Boden, New Lancaster, Fairfield county, Ohio; an alien, who has declared his intention to become a citizen. July 6.

In order to make 32 gallons of vinegar, two gallons of beer, ale, or porter, five and a third of whiskey, three ounces of cream of tartar, twenty-four and two-third gallons of water, are to be put together into a mixing tub, and afterwards into a vessel of convenient size for fermentation. The mixture is to drop through small holes in a division near the top of the fermenting tub, and to fall among chips or shavings of wood placed below it; a tube passes down from the top to the bottom, to supply the necessary quantity of air, and it is said that the mixture will become vinegar in about twenty-four hours. The claim is to the foregoing composition, and to the apparatus employed. It is not long since we read a description of the mode of making vinegar rapidly, as practised in Germany, which is as much like the foregoing as it could well be.

6. For an improvement in the *Art of Combing Wool*; Samuel Couillard, Boston, Massachusetts, July 7.

The following quotation will afford some general idea of the principles upon which the patentee proceeds in effecting his object, which is to separate the fibres of different lengths, and to bring them together when thus separated.

After describing the apparatus used, by written references to a drawing, he says, "upon this principle of drawing wool from the belt it can easily be seen that by placing a number of pairs of draw rollers at different distances from the belt, various lengths of wool can be drawn from it."

"What I claim as my invention is the revolving tooth belt, and the application of a card, or tooth cylinder, or cylinders, to comb wool into teeth passing by its surface, to produce the effect before described."

7. For an improved *Root Cutter*; Jonathan Clarke, Hampton, Windham county, Connecticut, July 7.

There is to be a revolving cylinder with knives placed diagonally, or otherwise, across its periphery, and the roots, placed in a hopper, are subjected to their action. The claim is to a machine having such knives, or slitters, a claim which has as little to support it as a large proportion of those made by patentees.

8. For a mode of *Applying Horse Power to Machinery*; Thomas Mitchell, Newburg, Orange county, New York, July 7.

An endless floor is to revolve upon cylinders in the usual manner, and under the slats composing it there are to be friction wheels running upon two rails. This apparatus is intended principally to drive thrashing machines.

Where the patentee can have been not to have seen such horse powers, which are extensively diffused over the country, it is not for us to tell, he must have seen but little, or he would not suppose the following claims valid.

"Horse power has been applied in boats on a horizontal wheel. The rotary chain bridge may have been used, but never to my knowledge with a rail-way, rollers, or inclination of the bridge herein described. I claim as my invention the inclined bridge rail-way and rollers, in combination with the other machinery before mentioned, but for which I make no separate claim; and although intended principally for the thrashing machine, I claim also the application of horse power by means thereof to machines for breaking flax and hemp, turning lathes, machinery for propelling boats, and all other machinery to which horse power can be advantageously applied."

9. For a *Safety Boiler*; George R. Clarke, Rochester, New York, July 7.

There is to be a cylindrical boiler of the ordinary construction, placed horizontally, and within this a second cylindrical boiler, connected with the former, but so much smaller as to allow of a space between the two, of probably two or three inches; the inner boiler is to contain the water, and should this explode, the outer case is to confine the steam, &c. until it has time to be conducted off by pipes for that purpose. The furnace, which extends along the under part of the boiler in the usual way, must, of course, heat the interior vessel without the intervention of the exterior coat.

This whole plan has so little to recommend it, or rather will stand so self-condemned in the view of all those who are acquainted with the subject as to prevent the necessity of animadversion on our part.

10. For *Cleaning Wool from Burrs, &c.*; M. N. Simpson, Boston, Massachusetts, July 7.

After giving a description of the machine intended to be used, the patentee observes that "wool from South America, and indeed almost all wools, have more or less of a vegetable substance, called burrs, so attached to it that it is not taken out by washing, and therefore the only mode of cleaning the wool has been by hand, until about two years since, a mechanic of the city of Boston, Mr. Lemuel Couillard, jr. invented a machine for the purpose, which performed the part of taking out the burr very well. but was set aside from the injury the staples received. The machine for which I now wish a patent performs the work of taking out the burr without any injury to the fibre. The wool should in the first place be well pinched by a common wool pincher, with the burr in it, and in this state the machine receives it; it is placed by the operation, on the feed belt, which when the machine is in operation is conducted to the draw rolls, which revolve very slow, and as the wool is carried through the draw rolls, the card cylinder takes it in small quantities in a thin state, as it revolves with so much greater rapidity than the feed rolls, and carries it in a continued direction by the clipper frame, which is placed nearly in contact with the surface of the teeth, the burrs and all foreign substances are stopped by the blade of the clipper frame, and the swift revolution of the clipper knocks them off. The wool continues in the teeth of the card cylinder, and is overtaken by the fan which is placed on the opposite side of the clipper frame, and is by the fan blown or taken from the cylinder and deposited in a clean state in the room which may be made for the purpose."

It is stated that the machine may be much varied in form whilst the same effect will be produced, and the patentee says, "I do not therefore claim as my invention any particular form of machinery to effect the object of detaching burrs or other foreign substances from wool, but claim the application of knocking, blowing, brushing, or striking the burrs or other foreign substances from the surface of the card teeth, or any other kind of teeth."

We think this claim may prove too broad, as it will be seen on turning to p. 187, vol. 13, that Mr. Couillard claimed, among other means, the "blowing or striking them off," when properly exposed; it may be, however that in the present machine the removal being effected from "the surface of the card teeth," may so far modify the thing as to prevent the one patent interfering with the other.

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11. For a *Thrashing Machine*; Joseph Tyler, Brooklyn, Windham county, Connecticut, July 7.

It is no easy task to find the means of making a cylinder thrashing machine in which there shall be anything admitting a legitimate claim to novelty; and it is quite manifest that the present patentee has not accomplished it. He has placed his main shafts to run upon friction rollers, than which few things are more common in machinery; yet he makes this a main foundation of his claim.

"The present claimant does not seek a patent for the cylinder, for the beaters, for the arbors, nor for the concave, because these parts of said machine have been long in use; but he does claim that the pinion wheel, balance wheels, the friction rollers, their size and proportions, and the modes of their application to this machine are entirely new, and are of the original invention of the present claimant. And also this claimant further claims as his invention, the great reduction of power necessary to propel this ma-

chine, and the great diminution of friction which has heretofore retarded in a great measure, the operation of machines of this description."

The latter part of the foregoing claim is merely to an effect produced, and it is a well established principle in law that a patent for a mere effect cannot be sustained. Any effect produced must result from certain means employed to produce it, and this latter is the only tangible object for a patent.

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12. For a *Water Pump*; Amos Miner, Elbridge, Onondaga county, New York, July 7.

The chamber of this pump is to be made of cast-iron, or other metal, and is to be attached to a wooden pump tree that is to lead down into the well. The wood part is to be coated with a cement of rosin and bees-wax, or other similar articles. Particular directions are given respecting the exact measurement of the respective parts, and the mode of connecting them with each other, but there is not in the description any thing that regards construction or arrangement which is worthy of particular notice, or that is in any respect superior to the pumps now in use. The following claims are made.

"1st. The general construction of the pump. 2nd. The application of the pit of the metallic piston to the cylinder of said pump. 3d. The application of the screw for connecting the wooden pipe, or tube. 4th. The manner of constructing the elbows of the pipe. 5th. The application of the resinous composition to the pipe or tube."

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13. For *Propelling the Stocks of Fulling Mills, &c.*; Elisha S. Norris, Monmouth, Kennebec county, Maine, July 7.

The mode of arranging the levers and joints is different from that usually adopted, but we do not perceive the advantage to be derived from this new plan, or its superiority in the various applications to which, judging from the following claims, it is destined in the mind of the patentee.

"The application of the knuckle joint, or levers, as described, to the fulling mill or washing machine, placing them, as delineated in the drawing, higher up on the stocks. The application of the same to mortising machines, and to the saw mill for sawing timber."

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14. For a *Door Latch and Lock*; Albert Bingham, Unity, Waldo county, Maine, July 7.

Many variations in spring latches and knobs for doors have been patented within a very few years. The claim made by the present patentee is a very brief one, being merely "the application of the dog to the knob as an inside fastening, as described."

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15. For an improvement in the *Compensating Tubes for Piano Fortes*; Thomas Loud, city of Philadelphia, July 7. (See Specification.)

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16. For a *Mortising Machine*; Israel J. Richardson, Palmyra, Wayne county, New York, July 7.

This patent is taken for an improvement upon the machine patented by the above named person, and Joseph Dennis, on the 19th of November, 1833, the improvements being made in the chisel, in the method of securing it and of moving the timber, and in the addition of an apparatus for mortising hubs. For the account of the former patent see vol. 13, p. 263. With the present specification is given an imperfect drawing, in which several of the parts described are entirely omitted, and to which there a e

no written references. The improvements in the chisel consist mainly, in making it of cast-iron, with a cutting edge of cast-steel soldered to it. The articles to be mortised are to be forced up by means of a screw; and the hub apparatus consists of a frame in which to hold the hub, and an index plate by which to set it, neither of which are new, and they are therefore in the same predicament with the original machine when patented. The claims made are not to any part of the apparatus, but to the advantages which may result from them.

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17. For an improvement in *Mills*; George and Francis R. Baker, Tuscaloosa, Alabama, July 7.

This patent is one great mistake, as the patentees use drums and belts for driving stones, or saws, and say, "we deem ourselves the first who applied bands, or leather belts, to the propelling of water mills for grinding and sawing." They claim "the arrangement of all the parts;" the whole of which are just as new as the drums and leather belts.

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18. For an improvement in the *Common Chisel*; George Payne, Keene, Cheshire county, New Hampshire, July 7.

This chisel is to be made with what are called wings, or side edges, for the purpose of pareing within mortises; they are intended principally to be used in mortising machines, but may be employed by hand. The claim is, "only the wings, or side edges," and even this might have been omitted, as such side edges are not new.

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19. For a *Substitute for Linseed Oil*; S. T. Todd, and J. L. Peabody, city of Washington, July 7. (See specification.)

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20. For an improvement in the *Saw Mill*; Ernst G. Augustin, city of New York, July 17.

The specification of this patent, and likewise those numbered 2, 3, and 4, are accompanied with drawings, lithographed, and furnished with numerous references; it is quite unfortunate that, although there are these aids, a proper attention to which would have rendered the drawing up of a good specification easy, those referred to all fail in every essential point, leaving us entirely in the dark as regards what the patentee considers himself to have invented. In the present case, the claim is to the "before described improvements, with the arrangement and adaptation of the several parts of the saw mill;" yet we are told in the commencement of the specification, that there is no change in the principal parts of the mill.

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21. For *Bending or Setting Felloes for the Wheels of Carriages*; Edward Reynolds, Haddonfield, Gloucester county, New Jersey, July 17.

The patentee says, "What I claim as my invention, is the machine, or apparatus, as herein described, and may properly be denominated revolving cylinders, to be used for the bending of felloes for carriages and wagons of all descriptions; sleigh runners; iron tires for wheels; coopers' set hoops, vessels' mast hoops, &c. In which machine two cylinders are employed, operated together by means of certain accessory parts, in the manner, or upon the principle, herein set forth."

We think the machine described well adapted to the bending of timber for rims for wheels. It consists of two wheels in a strong frame, the peripheries of the wheels being nearly in contact with each other; the timber, prepared by boiling, or steaming, is to be bent round one of them, by turn-

ing the other, which presses forcibly upon it. An iron band laps round the outside of the bent timber, to prevent its checking; and there are proper staples, and other appendages, for the management of the process.

22. For a *Cultivator*; Daniel Davis, Fredericksburgh, Spottsylvania county, Virginia, July 17.

The operating parts of this cultivator are formed very much like the mould-boards of ploughs, and three, or more, of them are to be attached to a cast-iron frame, which takes the place of the wood generally used in such instruments. The handles are to be of wood, and attached by bolts and sockets to the cast-iron frame. Particular admeasurements are given of the individual parts, which, with the cast-iron frame, appear to be relied on to sustain the patent. The claim is to "above described cultivator," which claim appears somewhat too sweeping.

23. For machinery for *Rolling up Curtains, Maps, &c.*; Henry Lawson, Boston, Massachusetts, July 17.

The handle by which the curtain, &c., is to be rolled upon its roller, is made much in the form of the old fashioned bell pull, and has a small sheever, or pulley, at its upper end; a cord, one end of which is fastened to and winds round the end of the roller, passes through the pulley, and has its other end fastened to a pin, or other attachment, above; this whole arrangement, it will be seen, is exactly similar to the hanging the weight of a common eight day clock.

"My claim is, 1st, for reducing the length of the draw required to roll up this species of roller blind, shade, curtain, map, &c., to a convenient hand's pull; that is, by one easy move of the hand, to cause the roller to revolve sufficiently to wind up any length of curtain, &c., required for the above purposes.

"2nd. For the pendent balance pulley, and the manner of applying it, as above described.

"3d. For the relative proportions of the barrel and axis, as above described."

All that is said about relative proportions, is, that one part is made *small*, and another *greater*. Rather an indefinite thing to claim.

24. For a *Churn*; Oliver Wyman, Dedham, Norfolk county, Massachusetts, July 17.

The body of the churn is, in preference, to be square, as being less expensive than if made round; it has in it a vertical shaft, with dashers; the shaft is turned by means of a winch and bevil gear.

The claim is to "the square churn; the construction of the dasher, and the gearing by which it is turned; and the operation of the several parts of the machinery to effect the purposes above specified."

We have seen several square churns; dashers and gearing like the above may be seen over and over again in the patent office; and the operation of the several parts is, of necessity, like the operation of the like several parts in other similar churns; at all events, the operation is not a thing to claim.

25. For a *Cooking Stove*; John Moffat, and Morton Taintor, Buffalo, Erie county, New York, July 17.

This is intended as an improvement on the "self-heat-retaining stove,"

patented by the above named John Moffat, August 13th, 1834. See vol. xv., p. 190, where the general construction of the stove is so fully set forth, that we need say but little respecting it, excepting to indicate the improvements; these "consist in having the reflectors in the ovens movable, or portable, instead of being fixed. Also, in having a hole near the bottom of the back side of the case, through which air is admitted into the space between the back of the stove, within the case." "Also, the making a steam pipe from the back side of the upper part of the case, to the flue of a chimney, or stove pipe, by which the upper part of the case is ventilated," &c. "And further, that *any kind* of stove which is, or may be, used for cooking or warming purposes, may be enclosed in a heat retaining case, (as described in the aforesaid letters patent, and in this specification,) and used *either for cooking purposes, or for heating air* to warm a house, by means of pipes connected with the several rooms."

"We claim the invention of the last mentioned improvements, as therein expressed."

Now, it is to be remembered, that, if the claim to the heat retaining case was good in Aug. 1834, it cannot be made again in July, 1835, or two patents may be held for the same thing. The parts now claimed as improvements are not adequately described, or clearly represented in the drawings.

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26. For an improvement in the *Manufacture of Potash*; Henry Hartsuff, Tyre, Seneca county, and Cyrus French, Aurelius, Cayuga county, New York, July 17.

The claim is to the "use of dry slacked lime and ashes, in alternate layers, and saturating each layer of ashes with *boiling weak ley*, in which common salt has been dissolved, by which the strength of the ashes is more perfectly obtained in a shorter time, and at less expense."

The directions given are, first, three inches of slacked lime, then five inches of ashes, saturated [moistened] as above; then half an inch of lime, and five inches of ashes, continuing to about five layers of each alternately. Water, or weak ley, is finally to be poured on, until the ashes are exhausted.

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27. For a *Mortising Machine*; Imla Wright, Centre Antrim, Hillsborough county, New Hampshire, July 17.

"The invention here claimed, and desired to be secured by letters patent, consists in the before described machine for mortising timber, with the arrangement and adaptation of its several parts, particularly in the stock, and adjustment of the stock and chisel."

This stereotyped claim will suffice to vitiate almost any patent for a machine to be applied to purposes to which many others have been previously applied; in the present instance, if there was any thing to claim, it must have been contained within very narrow limits, the general construction of the machine being without novelty.

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28. For a *Water Wheel*; Isaac Powell, Laurence, Otsego county, New York, July 17.

This is a reacting wheel, with little, if any, novelty about it; at all events, its characteristic features are not pointed out in the specification; and the claim is to "the before described reacting wheel, with the arrangement and adaptation of its several parts."

29. For a *Plough*; patented October 23d, 1829; patent surrendered and reissued upon an amended specification, July 17.

We have said all that we think necessary respecting this plough, at p. 35, vol. v. The present specification, though amended, does not, of course, alter the thing patented.

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30. For improvements in a machine for *Manufacturing Weavers' Reeds, Headles, or Harness*; Jephth Avery Wilkinson, Providence, Rhode Island, July 17.

Twenty closely filled pages are occupied by the specification of these improvements on a machine formerly patented by the same gentleman, and twenty-seven figures, with almost countless references in the drawing, forbid any attempt to offer a brief description of a thing consisting of parts "too numerous to be contained in a catalogue."

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31. For an improvement in *Looms*; Oliver C. Burr, Millbury, Worcester county, Massachusetts, July 17.

It is stated that it has been found very difficult to wind cloth upon the beam of a loom with regularity, as it is woven, and that those plans for doing it which have been successful, are too expensive. By the plan now patented, the beam is to move at each flight of the shuttle, instead of at longer intervals, and, if the thread on the spool breaks, the winding ceases.

By a particular contrivance, the proper explanation of which would require the drawing, the latter is made to communicate motion to the cloth beam, through the intervention of an arm, or lever, the employment of which constitutes the claim.

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32. For a *Churn*; Reding Ryerson, Jay, Oxford county, Maine, July 17.

The tub of this churn is to be upright, and in the usual form. A shaft passes through the lid, and its lower end is received in a step on the bottom of the churn. The shaft is to be turned by a face wheel and wallower, in the manner of bevil gear, and upon the shaft there are floats, or dashers, some of which are horizontal, and others vertical; the floats are called "cutting floats," and it is to these that the goodness of the churn is attributed, but in what particular they differ from others, so as to obtain their name and value, we are not informed.

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33. For a *Plough*; Samuel Cline, Plumstead, Bucks county, Pennsylvania, July 17.

The improvement in this plough is said to consist in "placing the line of draught, or beam, so that the resistance to be overcome may bear equally on both sides of that line." The mode of forming the plough so that the beam shall stand in the way mentioned, is particularly described, but this we do not think it necessary to detail.

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34. For a *Washing Machine*; Asa W. Soule, Portland, Cumberland county, Maine, July 18.

This washing machine has beaters, operating much in the manner of those of a fulling mill, and precisely similar to such as have been before used in washing machines. The arms on which these are suspended, are to be worked backwards and forwards by means of cams, having friction rollers on the ends; the cams and friction rollers constitute the claim.

35. For an improvement in the making of *Artificial Stone Coffins*; John White, Syracuse, Onondaga county, New York, July 18.

It is stated that this patent is obtained for an improvement upon that granted to Daniel Dayton, Hiram Hoyt, and the said John White, on the 6th day of June, for making coffins of American Hydraulic Cement. The improvement claimed consists in the filling in of the coffin, whether originally made of the cement, or of wood, with soft cement when the corpse is put in, for the purpose of excluding the air from the corpse, and also supporting the corpse when the coffin is placed in an erect position." When made of cement, the coffin, it is observed, "may be made of any shape desired; and, if to be placed upright, may be in that of a statue, &c.

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36. For an improvement in the *Manufacture of Cloth*; Freeman Wolcot, Stow, Middlesex county, Massachusetts, July 21.

This, so called, improvement in the *manufacture of cloth*, is, it appears, an improvement in the napping apparatus, by substituting combs of brass for the teazles usually employed in that process. These combs are made of strips of elastic sheet brass; the teeth in them are to be about an inch in length, a fifteenth of an inch wide at their bases, and tapering regularly to a point. To these plates "a considerable curvature is to be given by swaying; that is by placing the plate thus cut over a concave mould so fashioned as to give the teeth and plate a proper curvature, and then placing a corresponding convex iron over them, and giving it a blow with a hammer. The metallic napper will then be complete, and will be a plate with a row of curved tapering elastic teeth, resembling the teeth of the teazle, and standing out from the uncut part of the plate at such an angle that the uncut part may be attached to slats of wood passing across [along] the face of a cylinder at suitable distances."

"The invention for which, and for the use of which, the said Wolcot claims his patent, is for making from thin brass, a plate, with curved, tapering, and elastic teeth suitable for napping cloth."

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37. For a *Machine for Shelling Corn*, John P. Small, Gilmarton, Strafford county, New Hampshire, July 21.

This corn shelling machine has a cylinder set with teeth, and a concave against which it operates in the shelling process; it is, in fact, substantially the same with the first corn shelling machine ever invented. The corn falls through an opening at the lower part of the concave, and is cleaned by a revolving fan, in the way frequently practised.

The claim is to "the combination or manner in which the several parts are put together, in the manner above described," which claim might as well have been altogether omitted, as it does not render that new which is actually old.

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38. For an improvement in the construction of *Stoves for Burning Anthracite, and other Fuel*; Jordan L. Mott, city of New York, July 21. (See Specification.)

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39. For a machine for *Manufacturing Corks*; Jonathan Cutler, and Isaac Keyes, Putnam, Windham county, Vermont, July 21.

This cork cutting machine has a mandrel which revolves like that of an ordinary lathe. The cutters consist of four or any other convenient num-

ber of pieces of steel formed at their ends like an ordinary gouge. They are capable of expanding and contracting, as otherwise, they would cut the cork into a cylinder instead of making it conical. Each of the cutters is hinged, by a handle at its opposite end, to the revolving shaft, and there is a collar so contrived as to cause the cutters to approach each other as the cork is cut. In front of the mandrel there is a horizontal wheel, called a feed wheel, around the periphery of which there are notches to receive the blocks of cork wood, which are ready for the machine. A cam causes this wheel to carry each block, in succession, up to the cutters, into the hollow between which it is finally received, and passes out at a proper opening behind the cutters.

"What we claim as our own invention is the expansive, or cutting cylinder, as connected with the other machinery. Every other part of the machine may be constructed differently, and answer the same purposes."

This machine is skilfully contrived, and described with sufficient clearness; the claim, also, we think well expressed and sufficiently guarded; still, we have doubts of the eventual success of the plan, from the intrinsic difficulties which present themselves in the cutting of cork by machinery. There have been several patented contrivances for the same purposes, but we believe that neither of them has stood the test of continued use. Those who are acquainted with the operation of cutting corks by hand know that a thin and sharp knife is employed for the purpose, and that the edge of this knife is preserved by passing it over a piece of wood between every two or three cuts, the workmen doing this dexterously with one hand whilst the other is employed in taking up a fresh block; without this fine edge the cutting cannot be effected, and we think that in a machine it can scarcely be preserved. Besides this, from the varying thickness of the cork wood, it is no easy matter to have the blocks all of one size. In cutting by hand this is of no consequence, while in cutting by machinery it is all important.

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40. For an improvement in the *Combined Stove*; for which a patent was obtained on the 13th of December, 1833; Jordan L. Mott, city of New York, July 21. (See Specification.)

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41. For an improved manufacture of *Knobs or Handles for Stoves or Grates*; Jordan L. Mott, city of New York, July 21.

"My new manufacture consists in the employment of a material for making knobs, or handles, and for the above named purpose; which material is the metal denominated zinc, or spelter. I cast such knobs or handles either in moulds of metal, or in sand, in separate hollow pieces, and unite the same together by means of pins, or screws passing through them in the manner commonly pursued in uniting the parts of brass or other knobs employed for drawers or other purposes."

The claim corresponds with the above statement.

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42. For a *Churn*; Hiram Phelps, Willeston, Chittenden county, Vermont, July 21.

This churn is to be a square box, standing on legs, and having the bottom concave. Within the box a shaft is to be made to revolve, the floats of which come nearly into contact with the bottom. The particular arrangement of the floats, and the advantages which the patentee thinks will be derived from them we leave to be recorded by some future historian.

43. For the *Application of Asbestos to protect fire proof chests, &c. from the influence of excessive heat*; John Scott, city of Philadelphia, July 21.

"My improvement consists in the application and use of the same material (asbestos) in combination with substances and articles which have heretofore been exposed to the influence of fire without it, but will now derive greatly increased security and protection from its use. These articles are fire proof chests, boxes, closets, doors, and their different parts."

44. For an improvement in the *Slide Valves for Steam Engines*; Andrew M. Eastwick, city of Philadelphia, July 21. (See Specification.)

45. For a *Rotary Steam Engine*; Mason Young, Buffalo, Erie county, New York, July 21.

This machine is denominated "the spiral spring float propelling Rotary Steam Engine." Like most of its predecessors, it will prove a total failure. We do not mean by this assertion that it will not work, but merely that it will be found very inferior to the reciprocating engine, and that it will not, therefore, be kept going. A wheel is to revolve within a drum, or case, and this wheel is to have buckets, or floats, against which the steam is to act. These floats slide through mortises in the periphery of the wheel, and have shanks furnished with spiral springs to protrude them. They slide in as they pass a stop against which the steam is to react in driving the wheel. Those persons conversant with the miscarriages and abortions which have taken place among those enceint with rotary steam engines will at once perceive that in the foregoing affair there is nothing new in principle, and but little in arrangement.

How widely we differ from the patentee will appear by the subjoined quotation; our difference we apprehend, however, will be but temporary, as actual experiment, will, most probably, convince *one of us*, of his error.

"The advantages the foregoing application of steam possesses, consists in overcoming the *friction*, occasioned by the old method of crank and piston. Also obviating the difficulties arising from the *dead centres*, in the use of the crank and piston plan.

"By the invention or improvement above mentioned it is insisted that nearly all the lever purchase of the wheel is secured. That the expense of construction is greatly diminished, thereby bringing the steam engine into more common use. Lastly: a consideration more weighty than any other, the saving of fuel necessary in generating steam by this new method, by which less steam performs more labour according to the given diameter of the wheel, in nearly an inverse ratio.

"I claim, therefore, the application of the aforesaid method of using steam, as well as the manner of constructing the wheel with its appendages, the cam, or eccentric used in the shell, together with the manner of making the boxes with spiral spring."

46. For *Cutting Tenons on Spokes*; William Gerrish, Portsmouth, Rockingham county, New Hampshire, July 21.

This machine is for cutting round tenons by means of a revolving cutter, having in its centre an opening of the size proper to admit the tenon. There are to be three, or any other convenient number of, cutters projecting from the face, which forms the shoulder.

Such cutters have been used for many years for similar purposes, both in braces and in lathes, and there is not any thing in that now presented, essentially varying from, or in any respect superior to, those well known to workmen.

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47. For a *Churn*; Russel Brady, Williston, Chittenden county, Vermont, July 21.

This churn is so much like that No. 42, as to be evidently struck by the same die, notwithstanding the change in the superscription.

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48. For *Stoves*; Daniel West, and Ferdinand Van Sickie, Hudson, Columbia county, New York, July 21.

This stove the patentees call "*the external draught and rarifier*," and they say that "a more uniform, and a greater degree of heat is produced by the combustion of the same quantity of fuel, than in any other manner." The claim made is to "the rarification of the air, obtained from the outside of the room or building, before it is supplied or used for the combustion of the fuel, and the warming or heating the room or building with the surplus of the rarified air beyond what is necessary for the combustion of the fuel; also the grate aforesaid, whatever may be the construction, or however adjusted."

The stove consists of one cylinder within another, the inner one forming the furnace part, and projecting above the exterior case sufficiently high to have a door in it for the supply of fuel, and a opening for the smoke pipe.— Air is to be admitted from the outside of the room into the space between the two cylinders, a portion of which is to pass through an opening to feed the fire, and the remainder through perforations at the top of the exterior cylinder, to heat the room.

The grate is to be a convex segment of a sphere, and is to have a handle with which to tilt it. The whole affair is treated as though it were entirely new, instead of entirely old, with the exception, at most, of allowing a portion of the air from between the two cylinders to feed the fire; and this part is of little importance as it might be as well fed from a portion of that in the room.

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49. For a *Double Dasher Churn*; William A. Henrich, Greene, Kennebec county, Maine, July 21.

The churn may be of the common construction, with the exception of there being two dashers, one alongside the other; these are to be worked up and down by means of a crank, or lever, which is the thing claimed, but by how many we have not time to count.

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50. For a *Machine for Cleaning Rags*; William Debit, Hartford, Connecticut. First patented January 13th, 1829. Reissued on an amended specification, July 21.

The specification of the original patent will be found at p. 270 vol. iii. The claim in the present specification is in the following words.

"I do not claim as my invention the common duster, or any of its parts; nor the plates, the knives, or beaters, the hollow axles, the shafts, nor, in short, the several parts of the machine, taken by itself. But I do claim as my invention the aforesaid combination of the shaft, and said knives or beaters with the common duster, improved by said horizontal knives or plates

on the ribs, made to revolve so that the knives or beaters on the shaft shall pass rapidly by the ribs and plates of the duster. By these motions and combinations of parts, the rags are agitated, beaten and cleaned."

51. For a mode of *Regulating the height of water in Steam Engine Boilers*; Jesse Fox, Lowell, Massachusetts. Patented April 2nd, 1835; surrendered and re-issued, July 21.

We noticed the former specification at p. 306 of the last volume. The patentee has surrendered this patent, and has put in two new specifications, upon which two new patents have been issued; a procedure sanctioned by former practice, and also by the opinion of the Attorney General.

Without a plate and a very long description, the mechanical arrangement proposed by the patentee, cannot be made known; all we can do is to give a quotation in which the principle of the invention is set forth.

"The principle consists in ascertaining whether water or steam be at any point in a steam engine boiler when in use and operation, by means of a change produced in the action of a piston or plunger moving in a chamber of about four cubic inches, capable of holding in confinement the steam made in such boiler, and having a valve by which the steam or water, as either may be at such point during the operation of the engine, may enter from such boiler into such a chamber, and be confined there for an instant, while the plunger descends therein by means substantially as aforesaid; and the presence of either being ascertained by the change in the action of such plunger in the mode substantially as above described."

52. No. 2 of the foregoing.

To afford some idea of the difference of the modes described in the two specifications, we give the following quotation.

"It is now apparent that the change in the supply is produced by the compressibility of steam, and the non-compressibility of water made effective by machinery; steam opposing no resistance to the descent of the plunger suffers the dog to descend and draws the supply rod away from the boiler, thus increasing the supply as aforesaid; but water resisting the descent of the plunger, and arresting the plunger in its descent for an instant, thereby makes the plunger a temporary prop, and a centre of motion for the lever which is made to work thereon, and lift up the dog, so that the spring shall throw its lower notch upon the catch, and thereby carry the air towards the boiler, and with it the rod, thereby diminishing the supply of water."

#### SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a Patent for an improvement in the Slide Valves for Steam Engines.* Granted to ANDREW M. EASTWICK, city of Philadelphia, July 21st, 1835.

To all whom it may concern, be it known, that I, Andrew M. Eastwick, of the city of Philadelphia, in the state of Pennsylvania, have invented an improved slide valve for steam engines, by means of which the action of the engine may be reversed with the utmost facility, thereby rendering this improved valve of special utility in engines for steamboats, locomotives for rail-roads, and for other purposes; and I do hereby declare that the following is a full and exact description thereof.

The slide and steam chest do not differ in their general construction from those in ordinary use, but to the latter an increased length and depth are given, to admit of an additional sliding piece, which I denominate a *Reversing shifting valve seat*, and upon the use of which my improved valve is dependent; the permanent valve seat, also, upon the body of the cylinder, is furnished with openings into steam ways leading into each end thereof, and with an escape opening, which do not differ from those in ordinary use.

The reversing shifting valve seat, above alluded to, has five openings in it, three of which pass directly through it, and are so situated during the ordinary action of the engine, as to coincide with the steam ways, and discharge opening upon the cylinder. The other two openings do not pass directly through the shifting valve seat, but each of them, after descending nearly half way through the seat, is continued laterally, passing along by the ends of two of the direct openings first described, and terminating on the opposite face of the shifting seat; the two lateral communications are at opposite ends of the direct openings. By this arrangement of these two extra openings, the steam which is admitted into one of them, does not pass into the steam way which is directly under it, but into that leading to the opposite end thereof. In consequence of constructing the shifting valve in this manner, all that is necessary to reverse the motion of the engine, is to slide the shifting seat so as to bring the reversing openings into action, and to throw the ordinary openings out of action. For this purpose, a rod connected with the shifting valve seat passes through a stuffing box in the steam chest, so that, by means of a lever, cam, or other contrivance, it may be instantaneously shifted in either direction; the steam chest must, of course, be made of such length as is necessary for this purpose. The openings which are not in action are closed by the divisions between the steam and discharge ways, and by the solid parts of the valve seat.

What I claim as my invention, is the construction of the reversing shifting valve seat, containing the reversing openings, constructed upon the principle, or in the manner, herein set forth, whether the same be made precisely in the form described, or in any other which is substantially the same, producing a similar effect by analogous means.

ANDREW M. EASTWICK.

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*Specification of a Patent for an improvement in the Construction of Stoves for burning Anthracite, and other Fuel. Granted to JORDAN L. MOTT, city of New York, July 21st, 1835.*

To all whom it may concern, be it known, that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented an improvement in the construction of stoves for burning anthracite, and other fuel, which improvement is applicable also to retorts for gas works, and to other instruments for the generating or applying of heat. And I do hereby declare that the following is a full and exact description thereof.

For the purpose of description, I will suppose a vertical, cylindrical stove to be constructed, observing, however, that I do not intend thereby to limit myself as respects the form, position, or application, of the apparatus, but only to give an exemplification of a practical mode of carrying the principle of construction into effect.

The body, or furnace part, of this stove, is to be of cast-iron, and consists of any required number of separate rings, of such internal diameter as

may be required for the furnace. These rings are to be placed, or superimposed, upon each other to the required height; rims, or ledges, and corresponding grooves, or hollows, being cast upon their touching sides to keep them in their places. Holes are also to be cast in them, or ears formed on them, to receive rods, by which they may be confined together. The lower part of the stove, forming the ash pit, and its appendages, and also that part which is above the fire, may be constructed in any of the usual forms, or of any of the ordinary materials; the improvement made by me consisting entirely in the construction of that part which is formed of rings, or rims, in the way described.

I intend usually to form these rings so that, when put together, the interior of the furnace shall, by their junction, have a uniform, continuous surface, either cylindrical, conical, or otherwise, whilst the outside shall be fluted, ribbed, or grooved, so as to expose a large surface to the action of the external air, as this mode of forming them will, by its extended radiation, tend to prevent their being over-heated.

When used for gas retorts, their outsides will form one continuous surface, as best calculated to receive the action of the fire by which they are to be heated. When used in tubes for the conveyance, distribution, or management, of heat, they must, of course, be so formed as to adapt them to the particular purpose to which they are to be applied.

What I claim as my invention, and desire to secure by letters patent, is the forming the exterior, or shell, of furnaces, or fire-places, for stoves of various kinds, the bodies of gas retorts, and other apparatus which are to be exposed to great alterations of temperature, by the combination of separate rings, rims, or frames, of metal, usually of cast-iron, by which means any difference of expansion in the respective parts may take place without the danger of breaking, whilst any portion which is defective may be easily removed, and its place supplied.

JORDAN L. MOTT.

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*Specification of a Patent for an improvement in the Combined Stove, for which a Patent was obtained on the 13th of December, 1833. Granted to JORDAN L. MOTT, city of New York, July 21st, 1835.*

To all whom it may concern, be it known, that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented an improvement in the manner of constructing the stove for which letters patent of the United States were granted unto me on the 30th day of December, 1833; and I do hereby declare that the following is a full and exact description of my said improvement.

The combined stove, so called, and patented by me as above, was intended to unite the advantages of the close stove with those of an open fire-place; and I have heretofore been in the practice of casting the front part thereof in four separate pieces, namely, a front piece, two jambs, and the inclined plane, or curved plate, (described in my former specification,) which conveys the fuel into the grate; but I have found this procedure to be productive of considerable inconvenience, inasmuch as the ordinary defects in casting frequently rendered it difficult to adapt these pieces properly to each other, and more especially from the burning out of the lower edge of the inclined, or curved, plate. To obviate the first of these difficulties, I now cast the entire front, consisting of the inclined, or curved, plate, the hori-

zontal plate above it, forming the front of the close part of the stove, and the two jambs, from a single pattern, in one piece, with the exception of the lower and middle part of the inclined, or curved, plate, which, in order to obviate the second difficulty above alluded to, namely, the burning out of that part thereof which is in contact with the fire, I usually cast in a separate piece. This separate piece I make of sufficient length and width to sustain the whole effect of the fire, so far as the burning out of the curved, or inclined, plate is concerned; the separate piece, so cast, is received in a recess corresponding therewith, in the inclined, or curved, plate, and is retained in its place by suitable ledges, and a screw, or pin, attaching the two parts to each other. To give strength and durability to this separate piece, I form ridges, or reeds, along, or across, the outside thereof, leaving the inside smooth for the ready descent of the fuel. Although I prefer to make a separate plate in the way described, as, in case of its burning out, it is then readily renewed, without disturbing any other part, I sometimes merely form ridges, or reeds, upon the outside of the inclined, or curved, plate, cast in one continuous piece with the parts before named; such ridges, or reeds, occupying the part liable to be burnt out, and considerably increasing its durability.

What I now claim as my improvement on the combined stove, as patented by me at the within mentioned date, is the casting the entire front thereof in one piece, in the manner set forth, with the addition of ridges, or reeds, upon that part of the curved, or inclined, plate which is directly exposed to the fire; I also claim the making, or casting, of that portion of the inclined, or curved, plate which is so exposed, in a separate and distinct piece, in the manner, and for the purpose, herein fully set forth.

JORDAN L. MOTT.

*Remark by the Editor.*—We have a small stove of the above kind in use as a chamber stove, and have found it to operate extremely well. The coal burnt in it is such as we should formerly have considered as refuse, and which would have been thrown away.

## Progress of Theoretical and Practical Mechanics.

*Report on the use of the Hot Air Blast in iron Furnaces and Foundries.*

By A. GUENYVEAU, Engineer and Professor in the Royal School of Mines.

(Translated for this Journal, by Professor A. D. Bache.)

[Continued from p. 66.]

The following details confirm the abstract of results just given.

1st. *Furnaces using coke or coal.*

The results as to economy by using the hot air blast are stated, in the Scottish works, as nearly 3 to 2. At Vienne, the same quantity of coke which was used for 1.075 of ore and flux in the charge, is now used for 1.51. At La Voulte, where the air is heated only to 320° in the manufacture of iron for forging, 1 part of coke is now used to 2.1 parts of ore and flux. At the furnace of Terre-Noire, 1 lb. of coke is used to 1.82 of the mixed ore and flux.

At Torteron, where a mixture of coke (1-3) and charcoal (2-3) is used as fuel, 1 lb. of the fuel is used to 2.83 lbs. of the mixed charge, with the hot air blast. While at the furnace of Guerche, where they use the same ore,

flux and fuel, but with the cold air blast, 1 lb. of the fuel is used for 2.98 lbs. of the mixed ore and flux.

At Ancy-le-Franc where charcoal is used, in the proportion of 2-3 oak charcoal and 1-3 of white wood, 2.1 lbs. of the ore and flux require 1 lb. of fuel with hot air, and 2.5 lbs. require the same fuel with heated air. At Wasseraalingen, the increase of the mineral charge when hot air is used is 1.43 to 1, and at Riouperoux, 1.42 to 1.

When iron for forging only is made, and fuel is scarce, it is thought that the hot air blast will be of but little advantage; the company who use the patent for this blast have stipulated for the Creusot furnace, not to pay for the construction of the heating apparatus, in case no real advantage is derived from its use.

In those furnaces which use the hot air blast, and where the mineral part of the charge has been increased, the charges pass less rapidly than formerly, and there are, of course, fewer charges in a given time, but so much more ore passes in the same time that the run of iron is much increased. This increase is greater when the iron is made of the quality for forging than when made for casting. At Vienne, where iron of the second mentioned quality is manufactured, the daily yield has increased in the ratio of 1.22 to 1, while at Janon, where that of the first named quality is used, the ratio is 1.6 to 1. At La Voulte, they produce in twenty-four hours 8 or 9 tons of iron for forging, and it is stated that with an increase of the blast, the yield could be increased to 11 or 12 tons without injuring the quality of the iron.

The greatest advantage from the hot air blast is undoubtedly to be found in the diminution in the enormous quantity of fuel (coal) used in some of the English works. The results obtained in the works of the south of France are the following. At Vienne where they chiefly make iron for casting, they tried the Clyde form of heating apparatus, but abandoned it for that of Calder, by which they heat the air above the melting point of lead. The economy of coke has been in the ratio of 1.37 to 2.50. And the daily yield has increased from  $4\frac{1}{2}$  to 5 or 6 tons of iron. The daily product of the two furnaces at Janon, where Taylor's heating apparatus is used, is 8 or 9 tons of iron for forging, by the consumption per ton of 1.20 to 1.40 of coke. This does not include the fuel required to heat the iron. Each of the three furnaces of La Voulte turn out 9 tons of iron for forging, while with the cold blast they made but  $7\frac{1}{2}$  to 8 tons of the best quality, under the most favourable circumstances. The consumption of coke is now 1.25 to 1.30 tons for each ton of iron, besides about 600 lbs. per ton, which is required to heat the blast; the former consumption was 2.10 to 2.30 tons of fuel for one of iron. The experiments made in France with crude coal and the hot air blast, have not been conclusive in regard to its advantages, compared with the cold blast.

At the new Torteron furnace where charcoal (2-3) and coke (1-3) are used, the consumption of fuel is about the same for the two kinds of blast. With the hot air blast, however, they make excellent pig iron for castings without any difficulty.

## 2. *On the use of raw coal in smelting furnaces.*

The substitution of raw coal for coke is doubtless the source of the very great economy observed in the Scotch works, where the heated air blast has been introduced. It was generally believed in this country, as late as 1833, that the hot air blast was indispensable to the use of the fat varieties of coal, without cokeing. It was known that certain dry, bituminous coals,

might be used as fuel, even without admixture with coke, and without heating the blast, as is still practised in Wales.

In some of the English furnaces, on account either of the cakeing of the coal, or of its containing a considerable proportion of sulphur, coke is still used with the hot air blast. In one of the Welsh works, they partly coke the coal, and with good effect; a hint which may, perhaps, be improved upon here.

The following observations on the use of coal, of different qualities, with the common blast, have been collected.

A carbonate of iron was advantageously smelted at Vizille,\* with a mixture of coke, and of very compact anthracite, with the cold air blast. The high price of the coke rendered the manufacture unprofitable. It has been found at Creusot, that raw coal could be mixed with the coke used, in the proportion of fifty per cent. of the whole fuel, without injury to the quality of the iron, and without diminution in its quantity. At Decazeville, M. Coste found that all the neighbouring coals could be used with the cold air blast, and the furnaces there, as well as at Firmy, have since used no other fuel, except when it was necessary to work up the fine coal. The same weight of raw coal is now used as was formerly of coke. The pig iron has not deteriorated in quality, and the daily yield is the same as before, namely, about five tons.† In all these cases, there is an advantage resulting from the less quantity of earthy matters in the charges, than when coke is used; it has been found at Decazeville, that they require but half the quantity of flux used with coke, when raw coal is substituted for it.

A fact of an opposite kind was presented at Alais, where an attempt to mix raw coal with coke was unsuccessful, the yield of the furnace being sensibly diminished when the coal was but one-sixth of the charge. The coal appears, nevertheless, to be well adapted to this purpose.

At several of the furnaces, such as Terre Noire, &c., coke made from the fine coal is cheaper than the coarse coal, and no advantage can be realized by the use of raw coal.

In regard to the different kinds of coal, it has been observed that those which cake too much, or which fly to pieces, are both ill adapted to use in the smelting furnace. As to other varieties, they may be used either with or without admixture of coke.

The question as to whether the hot air blast is, or is not, necessary, seems to be undecided, observations being contradictory. It is possible that some kinds of coal may render the use of the hot air blast advantageous, or even absolutely require it, while others may work well with cold air. Some may require the hot air blast to drive off the bitumen before they reach the boshes, while others may not need such aid.‡

### 3. *Smelting furnaces where charcoal is used as a fuel.*

These furnaces requiring a less draught, and being lower than those for coke, are peculiarly well adapted for placing the heating apparatus at the trunnel head. At Wasseraffingen, the pipes are nearly vertical, and pass from the lower part of the furnace to the platform, and back again to the tuyeres; at Ancy-le-Franc they are nearly horizontal, and directly above

\* For an account of these important experiments, see this Journal, vol. xv., p. 346.

† In 1835, it is stated that the same furnaces run six tons per twenty-four hours.

‡ It is stated that, at Frederickshutte, in Silesia, a successful attempt has been made to smelt with raw coal as a fuel, and with the cold air blast. The coal does not cake readily. (Erdman's Chem. Journ.)

the trunnel head. An apparatus formed of curved pipes, passing in an arched form over the trunnel head, has been proposed by Mr. Taylor, but appears not to be as durable as that just referred to.

The experience of several years has proved that the heat of the combustible matters which take fire on issuing from the trunnel head, and of the other gaseous matters, will raise the temperature of the blast to 570° Fah. To this method of heating, several objections have been made; first, that in a well constructed furnace, the air issuing at the trunnel head should not be at as high a temperature as that required for the blast. This objection is not founded on observation, for, besides the heated gases which escape, and which do not burn, there are combustible ones escaping which take fire at the trunnel head, and give out heat by their combustion. It is a well known fact, that, in many works in France and Germany, the heat which would, otherwise, be lost, is applied to various useful purposes. A second objection is, that this mode of heating is dependent upon the proper working of the furnace, and may fail at the very time that heat is required to remove an obstruction in the furnace, from the effect of the very obstruction which is to be removed. This difficulty is easily obviated by burning a few fagots in the flues containing the air pipes, when extra heat is required.

In fact, this apparatus has proved generally satisfactory, requiring neither additional fuel, nor attendance. The exterior of the tubes should be cleaned about every fortnight, to remove dust, and other matters, which would impede the communication of heat. The cleansing of the long horizontal pipes, such as are used at Torteron, is an inconvenient matter.

It may be well to repeat, here, the results obtained by the hot air blast at Wasseraifingen. At a cost only of the construction and repairs of the heating apparatus, the daily yield of the furnace was increased thirty-nine per cent.; the quality of the iron, for casting, was not deteriorated; and the consumption of fuel was diminished from 1 to .61. The temperature of the air was from 390° to 400° Fah.

At Ancy-le-Franc, the consumption of charcoal per ton of iron was diminished twenty per cent., while the iron was improved for castings. The air was heated to 570°. The want of power of the blowing machine prevented a due supply of heated air, and the daily yield of the furnace was decreased.

I have been informed that there are several works in Franche-Comté, where they heat the air blast from the trunnel head. They have a greater daily yield, and consume less fuel than formerly, but state that the working of the furnace is not so regular as before. This, probably, depends upon some defect in their construction, since it certainly is not a usual accompaniment of the hot air blast.

At Hayange, (Moselle,) a furnace twenty-six feet in height, and using charcoal, was supplied with the hot air blast. By means of an apparatus like that used at Wasseraifingen, the air was raised to 612° Fahr., and even above this point. The area of the blast pipe was doubled, and the pressure slightly diminished. The charge of ore was increased from 450 lbs. for 22½ cubic feet of charcoal, to 680 lbs. The same number of charges were made per day, and the gain resulted only from the increase of ore in each charge. The heating apparatus has required no repairs since its establishment, a year ago. In another furnace, at the same place, the heating apparatus having given way, the cold air blast was resumed at an additional expense of twelve per cent. of charcoal, per ton of iron.

It is stated in a German journal,\* that, by heating the air from a hydraulic blowing machine, by an apparatus at the trunnel head of a furnace, a saving of twenty-five per cent. of fuel had resulted. The air was heated to 480° Fah.

At Plons, in Switzerland, they have used the hot air blast to advantage, the fuel being a mixture of wood and charcoal. Each charge consists of 81 lbs. of charcoal, nearly half being from hard, and the rest from resinous wood, and 198 lbs. of pine wood, which would have yielded 48 lbs. of light charcoal; of 220 lbs. of ore, containing 51 per cent. of iron, and 60 lbs. of an argillaceous flux. From 18 charges they obtain, in twelve hours, 20,196 lbs. of pig iron. The economy is reckoned at about 33 per cent.

These results are more satisfactory than those furnished by charcoal, alone, and cold air, or even than those afforded by charcoal and the hot air blast. So successful are they considered, that a saw mill has been established to cut the wood to the required size.

[TO BE CONTINUED.]

### *Hunter's Patent Stone-Planing Machine.*

In March last, a patent was granted to Mr. James Hunter, of Leys Mill, Arbroath, "for certain improvements in the art of cutting, or what is commonly called facing and dressing certain kinds of stone." The specification of Mr. Hunter's method has not yet been enrolled; but from a Report, with a copy of which we have been favoured, made to the proprietor of the Leys Mill Quarries (W. F. L. Carnegie, Esq.) by Messrs. Carmichael and Kerr, engineers, of Dundee, who were invited to see the method in actual operation at these quarries, and to verify the results, it appears to be immensely superior to any other hitherto devised. Mr. Hunter has seemingly realised that great desideratum, a power-machine for the cutting and dressing of stone, capable of withstanding the extraordinary friction to which it must be necessarily subjected. The dispatch with which immense blocks of stone are cut up and dressed, by Mr. Hunter's apparatus, is prodigious; yet the cost of tools is next to nothing—"only a half penny-worth of steel for every hundred feet of planed surface!"

*Report of Mr. Charles Carmichael, and Mr. John Kerr, Engineers, Dundee, on the power of Mr. James Hunter's Stone-planing Machine.*

Sir,—Agreeably to your desire, we have visited Leys Mill Quarries, and attended minutely to the performance of the stone-planing machines. These machines do their work most effectually, as the following experiments, which we witnessed, will testify.

#### *Experiment First.*

We went to one of the machines that had six stones laid on the bench, one of which was planed, and the second begun to be operated upon; while this was doing we took the dimensions of the other four stones, viz.:—

Number of Stones.	Length of Stones.	Breadth of Stones.	Thickness.	Finished Thickness.	Quantity taken off.
	<i>Feet. Inches.</i>	<i>Feet. Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1	5 3	2 6	3½	2½	1
2	5 0	2 8	3	3¾	¾
3	5 6	2 6	6	4¼	1¾
4	4 0	2 3	4	2½	1½

\* Erdman's Journal, vol. xviii, p. 340, 1833.

The average thickness of the above stones are given, but many parts of them were much more than the thickness stated. One of the broad finishing tools was blunted ere the experiment began, and was changed when No. 2 was in the operation of being planed. No. 3 was a very hard stone, and was what is technically called *yolk*, in planing which one of the roughing tools broke at the point; still it wrought out the stone, and was then replaced. A splinter came off the face of the last stone, when about half-finished, which was another cause of delay, as they had to go over it again; but, notwithstanding the delay occasioned by the breaking of one tool, by another being changed, and by having to go over the one-half of the last stone twice, yet the time altogether was forty-five minutes, being at the rate of sixty-five superficial feet per hour.

*Experiment Second, (same machine.)*

Five stones were now put on the planing machine, of the following dimensions, viz.:—

Number of Stones.	Length of Stones.		Breadth of Stones.		Thickness.	Finished Thickness.	Quantity taken off.
	Feet.	Inches.	Feet.	Inches.	Inches.	Inches.	Inches.
1	4	3	2	2	4 $\frac{1}{2}$	2 $\frac{1}{2}$	2
2	3	9	1	10	4 $\frac{3}{4}$	3 $\frac{1}{4}$	1 $\frac{1}{2}$
3	3	4	2	8	6	4	2
4	3	6	2	0	6 $\frac{1}{2}$	4 $\frac{3}{4}$	1 $\frac{3}{4}$
5	3	8	3	6	5 $\frac{1}{2}$	4 $\frac{1}{2}$	1

These stones were planed in forty-two minutes.

The above stones were taken from the quarries without selection, and the men that were working the machine were not informed of the object of our visit. Experiment First, began at half-past twelve o'clock, noon, and Experiment Second, was concluded at nine minutes past two; thus leaving twelve minutes for cleaning and reloading the bench of the machine. Had all the stones been 5 $\frac{1}{2}$  feet long, they would have been planed in exactly the same time, for the machine travels the distance for that length; so that nearly sixty-seven feet of surface would have been planed in forty-two minutes.

The stones, as they come from the machine, are remarkably smooth and straight on the face; and were it not for the shade left by the tools, we would be apt to think them polished, as they feel as smooth as a polished stone.

We were told by the foreman that, during the last week, there was planed 4,400 superficial feet, more than half of which was planed on both sides (indeed more than half of all the stones that leave the quarry are planed on both sides), by four machines. We saw the payment list for the week; the amount was

	-	-	-	-	-	-	£6	1	6
Add blacksmith for dressing and grinding tools	-	-	-	-	-	-	0	12	0
							£6	13	6

We were further informed by the manager that, during the last summer, there were upwards of 100,000 feet of pavement planed by four machines; and there was one thing that struck us most forcibly, which is the small degree of wear on the tools. Three shillings a week, or six pence per day, is the cost of the labour for dressing and grinding the tools of one machine; and the whole consumption of steel during the last year was under one hundred weight, so that, if we measure both sides of those stones that were actually

planed on the two sides, it will be seen that a pound of steel will plane 1,500 feet, or about a halfpenny-worth of steel for every 100 feet of planed surfaces.

There are now five machines working in the quarry, wrought by a steam engine of six-horse power, the steam cylinder of which is 16 inches diameter, stroke 2 feet. Besides the machines, the engine has to work two inclined planes, one of which is for dragging up the pavement from the quarry to the machines; the distance on the incline 48 feet, ascent 1 foot in 5; average quantity about thirty tons per day of ten hours.

The second incline is for dragging up the rubbish from the quarry to the place where it is deposited; distance 87 feet, ascent 1 foot in 4; quantity from 50 to 60 tons per day of ten hours.

The above shows what the engine is actually doing; and we have no hesitation in saying that the engine could work eight machines besides the inclines, without being overloaded; and our opinion is that a machine, on the average, is not much more than one-half horse power.

*Note by Mr. Carnegie.*

To explain the difference which is apparent between the quantity of planed stone, which, according to the statement of the engineers, *might* be produced in a given time by the machines, and the quantity stated to them as in one week actually sent to market, it is necessary to remark,—1st, That it is found in practice to be cheaper to dress the stones by the machine in the rough state and shapeless form in which they are taken from the quarry, and to square them by hand afterwards, than to follow the opposite course, as is done when the whole work has to be performed by hand; thus a great quantity of work measured by the engineers, but not available in the market, is nearly lost. 3d. A considerable quantity is required to be dressed over twice on one side, or on both sides, according to circumstances; thus the stones, No. 3, in Exp. 1, and Nos. 2, 3, 4, 5, in Exp. 2, being too thick, were redressed on the under side to suit the market. 2d. The quarry does not always afford stones of a size to fill the benches, when much power is lost, as the machine has to traverse the whole width. 4th. Other circumstances (such as bad weather, &c. &c.) which will readily present themselves to the minds of those conversant in these matters, always occur to prevent general results from attaining the extreme limit, which may be calculated as possible, from the data of a short experiment. Mr. L. C. having been present, can confidently testify as to the correctness and impartiality with which these experiments were conducted, and to the truth of the information furnished to the engineers by those in his employment.

*Lond. Mech. Mag.*

A TABLE  
Showing the number of Houses supplied by the Water Companies of London, &c.  
According to the Returns made to Parliament, in 1834.

Name of Company.	Number of Houses supplied.	Gross annual Income.		Average annual Expenses.*		Height of supply abov. Thames.		Average charge, for water per House.†		Amount of capital employed.		Average value of each share.		Profit per cent. on the capital.	
		£	s. d.	£	s. d.	Feet.	Galls.	£	s. d.	£	s. d.	£	s. d.	£	s. d.
New River	73,212	104,909	0 0	38,000	0 0	145	241	1 6	6	1,116,964	0 0	15,512	0 0	4	0
Chelsea	13,891	22,906	0 0	13,481	0 0	135	168	1 13	3	271,311	0 0	56	10 6	1	15
West Middlesex	16,000	45,500	0 0	18,000	0 0	155	185	2 16	10	404,263	0 0	68	8 9	3	0
Grand Junction	11,140	26,154	0 0	11,000	0 0	151½	350	2 8	6	334,174	0 0	60	4 3	2	10
East London	46,421	45,234	0 0	15,889	0 0	107	120	1 2	9	594,988	0 0	118	19 11	3	15
South London	12,046	8,839	0 0	4,000	0 0	80	100	15	0	245,306	0 0	98	0 0	2	0
Lambeth	16,682	14,808	0 0	6,500	0 0	185	124	17	0	182,553	0 0	144	17 8	2	6
Southwark	7,100	7,850	0 0	No return.		60	156	1 1	3	95,000	0 0	One person's property.		No re- turn.	

\* In this statement of annual expenses, there is no allowance to provide a fund for repairs, improvements, casualties, &c., which amount to a considerable sum.

† The average rate includes public buildings, breweries, distilleries, &c.; but the rate charged to many houses is only ten or twelve shillings; and all the water for extinguishing fires is gratuitously supplied—the conflagration of a single house commonly requiring from 700 to 1000 hogsheads.

The number of houses supplied in 1820, was 120,732; in 1827, 176,205; in 1833, 199,493; which shows an increase of 78,761 during thirteen years, although considerably more than 10,000 houses have been taken down to effect various improvements, &c., and none erected on the same sites.

## Progress of Physical Science.

*On some elementary laws of Electricity, by W. SNOW HARRIS, Esq. F. R. S.*

(CONTINUED FROM p. 70.)

7. The inductive effect of a quantity of electricity distributed upon a conductor is directly as the quantity and inversely as the distance between the electrified body and that in which induction is produced.

Induction is not modified by atmospheric pressure being the same in the air and in a partially exhausted receiver.

8. The attraction of an electrified disk for a neutral uninsulated one, varies inversely as the square of the distance between their planes, supposed to be parallel.

(a) This force is not at all influenced by the force or disposition of the unopposed portions of two conductors, being the same in disks as when they are backed by hemispheres, cones, &c. Two hemispheres therefore attract each other with the same force as two spheres of the same radii.

(b) The attracting force is as the number of attracting points directly, and their distances inversely.

(c) The attraction between two unequal circular areas is equal to that between two areas each equal to the lesser.

(d) The attraction between a circular ring and a circle is the same as between two rings.

(e) The attraction between a sphere and a spherical segment of the same curvature, is the same as between two spherical segments equal to the one used.

A point may be determined in each of two hemispheres where the whole attractive force may be supposed to reside. The distance of this point from the intersection of the line of nearest approach of the spheres with the spherical surface is  $z = \frac{(a^2 + 2ar)^{\frac{1}{2}}}{2} - a$ , where  $a$  is the least distance between

the spheres and  $r$  the radius of each. The attractive force will vary as  $\frac{1}{a(a + 2r)}$ .

9. "It is demonstrated, that the resistance of the air to the passage of electricity is as the square of the density directly, so that a given quantity, having a given intensity, and about to discharge [from] or flow upon a given point, will remain in the same relative state in air of half the density, if the distance between the points of discharge be doubled; or generally if as the density of the air be decreased the distance between the points of action be increased, the electrical accumulation will still remain complete. If therefore, the density of the air be indefinitely diminished, and the distance between the points of action indefinitely increased, we shall have eventually the same relative electrical state continued, without dissipation; so that if we imagine the opposed body to become nothing, then the accumulated electricity will not tend to leave the electrified body at all, supposing it to be without the influence of all other substances. Discharges of electricity under a diminished atmospheric pressure do not seem to occur so much in consequence of a tendency of the electric principle to evaporate, as it were, in all directions into space, but rather in consequence of the removal of the non-

conducting particles interspersed between the points, *from* and *towards* which, the accumulated electricity tends to flow. It is hence extremely doubtful, whether a general distribution of electricity in mere space would ever occur, supposing the electrified substance to be the only existing body in the universe: directly, however, that we assume the existence of another body, there is a space devoid of resistance, the resulting induction would generate an attractive force, which, however small, would cause an electrical current to flow through a distance, however great."

This most singular deduction is supported by the following direct experiments. A sphere of brass was placed in the centre of a glass globe and supported there by a brass stem which was connected with a delicate electroscope. No collapse of the leaves of the electroscope had occurred when  $\frac{5}{80}$ ths. of the air had been withdrawn from the globe.

Under an adequate attractive force electricity passes more readily over the surface of bodies in a rarified medium.

10. The recession of electrified bodies from each other does not depend upon the action of the air in which they are placed, the repulsion of two gold leaves placed in a larger receiver being maintained undiminished when  $\frac{2}{300}$ ths. of the air was withdrawn.

"Electrical divergence is, unquestionably, an extremely intricate phenomenon. If it be assumed to depend on a repulsive force immediately impressed upon the molecules of certain kinds of matter, then it must be admitted to be a species of repulsive action essentially different from any repulsive agency in nature of which we have the least experience. Its operation is at great distances, and is exerted between distinct and concentrated accumulations of the repulsive matter disposed on the surfaces of bodies; and whilst thus exerted at sensible distances, it is either altogether controlled by some other force, or otherwise so feeble as to be incapable of producing an electric diffusion by expansion, under an extremely diminished atmospheric pressure."

*Experiments to measure the velocity of Electricity, and the duration of Electric Light.* By CHARLES WHEATSTONE, Esq., Professor of Experimental Philosophy in King's College, London.

The continuance for a certain time of all luminous impressions on the retina prevents our accurately perceiving, by direct observation, the duration of the light which occasions these impressions; but by giving the luminous body a rapid motion, which produces the appearance of a continued train of light along the path it has described, its condition at each moment may be ascertained, and consequently its duration determined. The same law of our sensations precludes us from direct perception of the velocity with which the luminous cause is moving, as the whole of its track, for a certain distance, appears to be equally illuminated; but by combining a rapid transverse motion of the body from which the light proceeds, with that which it had before, its path may be lengthened to any assignable extent, and both its duration and its velocity will admit of measurement. The author gives various illustrations of this principle, and of his attempts to apply it to appreciate the duration and the velocity of the electric spark. His first experiments were made by revolving rapidly the electric apparatus giving electric sparks; but in every instance they appeared to be perfectly instantaneous.

He next resorted to the more convenient plan of viewing the image of the spark reflected from a plane mirror, which, by means of a train of wheels, was kept in rapid rotation on a horizontal axis. The number of revolutions performed by the mirror was ascertained by means of the sound of a siren connected with it, and still more successfully by that of an arm striking against a card, to be 800 in a second. The angular motion of the image being twice as great as that of the mirror, it was easy to compute the interval of time occupied by the light during its appearance in two successive points of its apparent path, when thus viewed; and it was ascertained that the image passed over half a degree (an angle which being equal to about an inch, seen at a distance of ten feet, is easily detected by the eye) in the 1,152,000th. part of a second. The result of these experiments, as regarded the duration of the spark, was that it did not occupy even this minute portion of time; but when the electric discharge of a battery was made to pass through a copper wire of half a mile in length, interrupted both in the middle, and also at its two extremities, so as to present three sparks they each gave a spectrum considerably elongated, and indicated a duration of the spark of the 24,000th part of a second. The sparks at both extremities of the circuit were perfectly simultaneous, both in their period of commencement and termination; but that which took place in the middle of the circuit, though of equal duration with the former, occurred later, by at least the millionth part of a second, indicating a velocity of transmission from the former point to the latter, of nearly 288,000 miles in a second; a velocity which exceeds that of light itself.—*Proceedings of the Royal Society, June 14, quoted in Arcana of Science, 1835.*

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*On the Repulsive Power of Heat. By the REV. BADEN POWELL, Savilian Prof. Geom. Oxford.*

Prof. Powell examines an experiment of Signor Libri, from which the repulsive power of heat was inferred, namely that when a drop of water was placed near the end of a wire placed horizontally, or even inclined a little upwards, on heating the wire the drop receded from the heated part. A repetition of this experiment produced only a slight motion explicable by the increased vaporization on the side next to the heated part of the wire. A drop of oil placed in a capillary tube, when part of the tube is heated, recedes from the place of heat, because the tube is rendered slightly conical. No effect was produced on liquids contained in capillary tubes though heated until they boiled, nor on a drop between two inclined plates which were heated, nor on a globule of mercury suspended from a glass plate, by heating the plate.

Mr. Fresnel placed disks of foil and mica before a delicately suspended magnetic needle, and brought them against fixed disks, when the needle was a little inclined to the meridian so as to press the disks together. On applying the heat of a lens to the disks they separated. The experiment was made in a highly rarified medium. Professor Powell repeated the experiment, remarking that the effects might be produced by the greater heat of the surface exposed to the sun's rays, which would render it convex. By pressing the disks closely together, the coloured rings formed would give a test of the interval between the disks. The tints invariably descended in the scale when heat was applied, showing that the intervals between the disks increased. By using two lenses the exact amount of the interval may

be calculated. The effect of expansion will be, when a convex lens is placed upon a plane, or convex, or even upon a concave surface of less curvature than the lens, to diminish the angle between the lens and surface, and so to cause the rings to enlarge. But on the contrary they regularly contract and the central tint descends in the scale until the whole vanishes, by an increase of interval. This it would seem must be due to a real repulsive power developed by heat.

From experiments made by the contact of a lens with different substances, Prof. Powell infers that whatever tends to increase the rapidity of communication of heat, tends to increase the observed effect. The effect is increased when water instead of air is introduced between two lenses.

*Abstract fr. Royal Soc. Trans.*

### *The Aurora Borealis as a Prognostic of the Weather.*

The view intended to be enforced in the following extracts is that a display of the Aurora is immediately succeeded by high winds and storms.

1. *Notice of instances of the appearing of the Aurora Borealis, seen from Dundee, Perthshire, in 1833 and 1834, and the state of the weather subsequent to the several instances.* By WM. GARDINER, Jr. Esq.

"These northern illuminations have been very frequent of late as the subjoined list of dates of their occurrence in 1833 and 1834 will show. From circumstances, I have been unable to make scientific observations on these interesting phenomena, but the statements I communicate are facts, and facts however simple and apparently of little value in themselves, often come to be useful. The object I have in view, you will perceive, is to establish that the Aurora may be relied upon as a sure prognostic of the weather. From the observations which I now bring forward, as well as a multitude of similar ones made prior to 1833, I have learned that an Aurora is *always* succeeded by moisture, and frequently by storms, that are in general, proportionate to the brightness, extent and length of duration, of the luminous manifestation."—[*Loudon's Mag. of Nat. Hist.* No. 46.]

2. *Remarks Contributive to the Elucidation of Meteoric Atmospheric Phenomena.* By W. H. WHITE, Esq.

I have been thus particular in a detailed account of the weather during the latter part of December 1830, because I have generally found variable and stormy weather to succeed Auroras, particularly if they were accompanied with many meteoric appearances. During the period of my observations of atmospheric and meteoric showers, I have invariably found that a gale of wind, generally from the S. or S. W. has followed an aurora within thirty hours, or at most thirty six hours; but differing in degree according to the splendour and magnitude of the aurora, and meteoric appearances; and therefore I think the following observations will hold good. The more splendid and active an aurora is, the more violent, and, consequently, in the shorter period, is the gale that succeeds, and the shorter its duration; and on the contrary, the more languid and dull the aurora appears, the longer the gale is in approaching, the less its violence, and also the longer its continuance. I should feel obliged by the observations of other gentlemen on this interesting subject, because, if the fact be universally true, particularly in high latitudes, of what importance would it be to our navigators, especially in the Northern Ocean, to pay particular attention to those interesting phe-

nomena, as they might be enabled to prepare against the storm which that appearance may be said to predict.—[*Loudon's Mag. Nat. Hist.* No. 46.  
Old Kent Road, Dec: 10th, 1834.

3. *Aurora Borealis*, of Oct. 12, 1833.—Mr. Fielding who describes a splendid display of the Aurora, seen at Hull, England, on the evening of Oct. 12, 1833, states that it was followed by a sudden fall of temperature in the air. The wind on the next day was from the east, inclining to the south, and in the evening blew in gusts from the south west. There were showers of rain on the evening of the 13th.—[*Loudon's Mag. Nat. Hist.* No. 37.

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*Dark Colour of the Sky at Considerable Heights in the Atmosphere.*

Dr. Barry read a paper on the dark colour assumed by the sky in the higher regions of the atmosphere, and instanced his own observations on ascending Mont Blanc. At a particular elevation, when surrounded by fields of snow, the sky deepened in tinge, and became dark violet; this he endeavoured to prove to be the effect of certain rays emanating from the snow, and received upon the retina of the eye. In order to shut out this influence, he stretched himself on his back, and giving the eye a short rest, the dark colour disappeared, and various shades, more or less, developed as he shut out or admitted those rays, to his vision. These various shades, and the corresponding influences which gave rise to them, he very ingeniously reduced to a scale, and illustrated them by comparison with the various tints afforded in the decomposition of light by the agency of the prism.  
[*Proceedings of Brit. Assoc.—Rep. Pat. Inv.*

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## Civil Engineering.

*Observations on the Motions of Shingle Beaches.* By HENRY R. PALMER,  
Civil Engineer.

The object of Mr. Palmer is exclusively practical, and his observations intended to furnish rules for controlling the motions of a beach, so far as to preserve a clear channel through it at all seasons, and in every variety of weather.

1. The motions to be explained. That the pebbles which compose the shingle beaches on these coasts, [Kent and Sussex, Eng.] are kept in continued motion by the action of the sea, and that their ultimate progress is in an easterly direction, are facts long known, and commonly observed. The following observations are chiefly directed to the particular manner in which the motions are produced.

From a general view of the effects which I have noticed, it appears that the action of the sea upon the loose pebbles is of three kinds; the first heaps up, or accumulates, the pebbles against the shore; the second disturbs, or breaks down, the accumulation previously made; the third removes, or carries forward, the pebbles in a horizontal direction.

For convenience, I propose to distinguish these by the following terms, viz: the first, the accumulative action; the second, the destructive action; the third, the progressive action.

All the consequences resulting from these various actions are exclusively referable to two causes; the one to the currents, or the motion of the gener-

al body of the water in the ebbing and flowing of the tides; the other to the waves, or that undulating motion given to the water by the action of the winds upon it; and it is of considerable importance to the present inquiry, that the effects resulting from each specific cause be separately considered.

The motion of the shingles along the shore is commonly attributed to the currents, the action of the waves being considered only as a disturbing force.

That the current is not the force which moves the pebbles along the coast, will appear from the following reasons.

1st. If it were so, the direction of the motion of the pebbles would be determined by the currents; but while the direction of the currents will vary with the change of the tides, we find that the direction of the pebbles may remain unaltered; and also, that the motion of the pebbles is continued when no current exists.

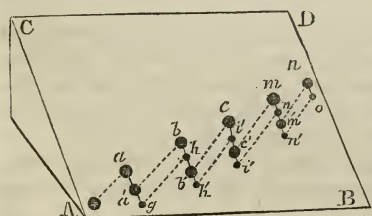
2d. Although the velocities of the currents may not have been ascertained with precision, yet it is known that the velocities, generally, along this coast, which can possibly act on the shingles, are not sufficient to give motion to pebbles of every dimension, which are, in fact, carried forward.

3d. That the motion of a current will not produce that order in which the pebbles are found to lie, which order, as will hereafter be shown, may easily be distinguished as the effect of the motion of the waves only.

The direction of the waves is determined principally by the wind, the prevailing direction of which, on the coasts referred to, is from the westward. Every breaker is seen to drive before it the loose materials which it meets; these are thrown up the inclined plane on which they rest, and in a direction corresponding, generally, with that of the breaker. In all cases, we observe that the finer particles descend the whole distance with the returning breaker, unless accidentally deposited in some interstices; but we perceive that the larger pebbles return only a part of the distance, and, upon further inspection, we find that the distance to which each pebble returns, bears some relation to its dimensions. This process is an indication of the accumulative action.

But, under some circumstances, depending upon the wind, it is found that pebbles of every dimension return with the breakers that forced them up the plane, and that these are accompanied also by others, which have been previously deposited, but which are, in such cases, disturbed by the waves; and by a continued repetition of the breakers acting in this manner, the whole of the shingle previously accumulated is immersed below the surface of the water. This process is an indication of the destructive action.

The particulars of the accumulative action, combined with that of progression, are explained as follows.



Let A B C D be an inclined plane, representing that on which the loose pebbles move. Suppose the wind to blow in such a direction as to cause a wave to strike a pebble at A, in the direction of A,  $a$ , and to the distance ( $a$ ) up the plane, that point being the extent to which the force can reach. Now here the wave breaks partly into spray, and is dispersed in all directions, is partly absorbed, and descends in a shallow form, which rapidly diminishes in its depth, so that the pebble is soon left

exposed, and, therefore, does not return the whole distance with the water, but is left at rest at  $a'$ , being at a higher level than that from which its motion commenced.

With the rise of the tide, the striking force is also elevated; and by the repetition of the operation described through the different heights in succession, the further motion of the pebble will be represented by  $abcm$ , &c., the distance in each step of its descent being something less than in that of its ascent, until it has reached the summit ( $n$ ) determined by the height of the tide. Now, if we suppose a pebble of less dimension than the former to be struck from the same point, we shall find it raised as before; but, because its surface is greater in proportion to its weight, and because, from its less bulk, it remains longer immersed in the declining wave, it will descend further, and follow the line  $ag$ , &c., and will not be left at rest till it has reached  $o$ .

So much effect has been attributed to the motion of the tidal currents, that vast sums have been expended in attempts to divert the motion of the shingles to a distance from the shore, from whence, by the increased depth and velocity of the current, it has been expected they would be carried past a particular spot, through which a permanent open channel has been required. Such attempts have been made at various periods, during upwards of two centuries, at Dover, and more recently at Folkstone, in the same neighbourhood. It is hardly necessary to observe, that they have not been successful, and, from the principles which I have laid down, their failure may easily be accounted for.

If a wall, or pier, be extended from the shore into the sea, it is evident that such erection will, in the first instance, impede and prevent the progressive motion; that motion is again restored, and the general mass proceeds as if no impediment had existed.

The most perspicuous evidence of these results is exemplified at the harbour of Folkstone.

Previously to the commencement of this exclusively artificial work, the beach traveled along the line of the cliff in the ordinary way.

By extending the walls a sufficient distance into the sea, it was expected that a commodious harbour would be formed, and the shingles diverted so far into deep water, that they could not again appear above the surface until they were removed beyond the harbour's mouth.

The accumulation, however, immediately commenced, and continued as the work advanced, until it became apparent that no other effect was produced upon it than a comparatively slight change of direction; the entrance of the harbour being much encumbered with shingle, an additional pier, or jetty, was erected, and extended about two hundred feet further into the sea, without having approached the effect intended. It is true, that some advantage was derived from the extended pier, by increasing the distance between the most violent action of the breakers, and the still water of the harbour. The shingles, therefore, pass the mouth in a more dispersed form than they originally did, and hence they do not as readily form a barrier, neither does its perpendicular height become so great.

If, then, it be admitted that projecting piers will not prevent the encumbrance about the mouth of a harbour, situated, as those referred to, in the tract of the restless beach, it remains to be seen how far such works may be otherwise injurious.

While the accumulative action is going on, every abrupt projection from the coast is an impediment to the progressive motion of the beach, till its

angle is filled up. Such abrupt projections offer no protection against the destructive action; when, therefore, by the increase of the wind, the action of the sea becomes violent, an accumulation previously caused by a projecting pier is rapidly removed, and again is rapidly deposited where it is not resisted. And there is, perhaps, no combination of circumstances less capable of resisting, or more favourable to the deposition of, the shingle, than is found in artificial harbours, shielded by an *abrupt* weather pier on a line of beach.

With a long continuance of violent winds from the same quarter, every accumulation of loose shingle is broken down, and is hurried forward, whilst it unremittingly appears to seek protection. During the recent gales, every inlet within the tract of the beach was seriously encumbered with it, commenced with the heap accumulated by the very pier that was intended to prevent such an effect, (where such existed,) and increased by the successive arrivals of those more remote, together with that quantity commonly passing along the sloping plane, but now brought down by the destructive action, and forced along with accelerated motion.—[*Abst. Phil. Trans.* 1834.

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#### *Liverpool and Manchester New Canal.*

We understand that it is intended to form a canal between Liverpool and Manchester, parallel with the famous rail-way, and nearly of the same length viz: thirty-two miles.

The new canal is intended for the cheaper conveyance of the passengers, luggage, light goods, and parcels which are now carried by the Liverpool railway coaches and wagons. This undertaking owes its origin to the unprecedented success, in point of despatch and cheapness, of the light passenger boats on the Scotch canals between Paisley, Glasgow, and Edinburg, and to the invention of a new apparatus for passing light boats rapidly up and down the ascents and descents of canals without loss of time or expenditure of water.

This apparatus is now in the process of being established on the Forth and Clyde canal. It is simple in its form and cheap in its construction, and from the length of the boats, being unrestricted by locks, a great additional buoyancy to the boats and consequent increase of their velocity is obtained.

With respect to the cheapness and speed of this conveyance, the experience of several years has now fully proved that passengers and light goods are easily and regularly conveyed on canals in light iron boats drawn by two horses, and accommodating from 100 to 150 passengers; at a speed of 10 miles an hour and upwards, and at fares less than one third of the Liverpool railway fares, and from thirty to forty per cent. less than the actual cost of outlaid expense of conveyance on the Liverpool railway, and it has also been ascertained that the speed on canals can, if necessary, be increased to twelve miles an hour.

The cost of making the new canal perfectly complete, is estimated at 250,000*l.* or nearly 8,000*l.* a mile. It will require no locks, and only a small reservoir to supply the evaporation of water in summer. It will have a towing path on each side; that is, one for the horses in each direction. The time consumed in the journey between Manchester and Liverpool, (including that of the omnibus conveyance at each end) will not exceed three hours; the great obstacle to speed arising from locks, and restricted length of the boats to suit the locks, being now removed.

The fares to passengers in the new canal, will not exceed the rates charg-

ed to passengers on the Paisley Canal, the average of which hardly exceeds one half penny per mile. The average fare on the new Liverpool and Manchester Canal will therefore be about one half penny per mile: or from seventeen pence to twenty pence for thirty-two miles, the distance between Liverpool and Manchester.

This average rate of fares is less than one-third of the average rate of fares exacted from passengers on the Liverpool railway, and from thirty to forty per cent. under what the Liverpool Railroad directors have, in their printed reports, stated to be their outlay on each passenger conveyed by them between Liverpool and Manchester. At this low rate of fares the proprietors of Scots canals, and particularly the Paisley Canal, have during the last four years, been increasing the number of their passage boats, and the frequency of their voyages or trips. On the Paisley canal the boats start from Paisley to Glasgow twelve times a day—that is hourly, and as often from Glasgow to Paisley.

There being little trade between Edinburgh and Glasgow, the trips of the boats on the canals between the two cities, are not so frequent as on the canal between Glasgow and Paisley. But the number of miles run by the passage boats on the canals between Edinburgh, Glasgow and Paisley daily, are upwards of nine hundred miles; whilst the total number of miles run daily by the passenger coaches and uncovered wagons on the Liverpool and Manchester railway, amounts only to 550 miles daily.

Another striking fact is certain. The gross amount of the fares levied daily for running these 900 miles on the canals, does not much exceed one-half of the sum stated by the railway directors as the actual cost of running 550 miles on the Liverpool railway. And yet a large proportion of the canal receipts are profits to the canal companies, who have been thereby induced to go on regularly in improving their passage boats, and increasing the number of their voyages.

On the canal between Liverpool and Manchester, it is proposed that a boat shall start from Manchester to Liverpool, and another boat from Liverpool to Manchester, at the end of every hour, for twelve hours daily, thus giving twelve opportunities from Liverpool to Manchester, and as many from Manchester to Liverpool, and running 768 miles daily, or 280,325 miles in the course of the year.

The boats are to be constructed and fitted up in the same manner as those on the Paisley canal, with two neat cabins, which will easily accommodate from one hundred and twenty to one hundred and fifty passengers, or three thousand six hundred passengers daily.

The cost of running these boats, stated at the same rates as on the Paisley canal, will be £11,000 yearly, including interest of the capital or cost of the boats and of the horses employed in drawing them, and a sinking fund to compensate their deterioration, and provide for their replacement.

The above calculations are based upon the actual cost of running exactly similar boats and some larger boats on the Scots canals. From the great extent of the trade, wealth and population of Manchester and Liverpool, compared with Paisley and Glasgow, the quantity of passengers and goods conveyed on the canals between Paisley and Edinburgh, must be altogether trifling compared to that which will be conveyed by the canal between Manchester and Liverpool; and judging from what has already been effected by the increased speed and unparalleled cheapness of the improved iron boats on the Scots canals, it is calculated that the light iron boats on the new canal between Manchester and Liverpool will be amply supplied with goods

and parcels, and that the revenue arising from the trade will be at least 20 per cent. on the capital expended.

A very large revenue, also, may be assuredly expected from night boats, carrying light goods, parcels, luggage and passengers, at lower rates than during the day, as has for several years been done on the Forth and Clyde, and Union Canals between Edinburgh and Glasgow. In these night boats the charge for a parcel not exceeding one stone in weight will be only 4d. which is just one third of the Liverpool Railway charge.

When it is considered that the average fares to passengers on the famous Liverpool Railway are from triple to quadruple the average fares in the neat and comfortable cabins of canal passage boats, running ten miles an hour, and that many of the railway passengers are conveyed in uncovered wagons, the success of the proposed undertaking may be considered as perfectly secure. For even supposing the railway company (encouraged by their corporate privilege exempting the partners from being liable for the debts of the corporation) were to reduce the fare of their passengers to the mere outlay or cost of the conveyance, it will be from thirty to forty per cent. above the canal fares, which after defraying all expenses, afford a handsome profit or dividend to the canal proprietors.

Unlike the railway, the new canal will furnish accommodation to all the country on its route, equal to that given by the railway to the towns only at each extremity; for passengers on the canal can be received or landed by the boats whenever required.

The whole line of the canal may thus, from frequency and ease of access, become like a main street connecting Liverpool and Manchester, and furnish sites for all kinds of manufacturing and chemical establishments, the canal affording a constant and abundant supply of water.

As soon as the new canal is fairly established and the quiet, smoothness, speed and unrivalled cheapness of the conveyance are experienced, we may expect to have opportunities not merely every hour, but every half hour, of passing between Manchester and Liverpool, at one third of the expense by the railway.—*London Public Ledger.*

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### Mechanics' Register.

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*Authorship of an improved method of setting rails.*—A suggestion to the following effect will be found in Prof. Barlow's report, page 127, vol. xvi. of this Journal. "I suggest as a matter deserving the attention of practical men, that as the bar must necessarily contract, it will draw from that end which is least firmly fixed, and hence all the shortening will probably be exhibited at one end however slight the hold on either may be; and when it happens that the adjacent ends of two bars both yield, the space is double. To avoid this evil, one of the two middle chairs in each bar might be permanently attached to the rail, in which case the contraction must necessarily be made from each end."

In a very rough article in the August number of the London Mechanics' Magazine the credit of the suggestion is claimed by Mr. James Woodside, one of those competitors whose plans Prof. Barlow examined. In the mildest tone of rebuke, the Professor replies, admitting that the suggestion is certainly due to Mr. Woodside, although he had not recollected having so derived it when his report was written, and adding that while Mr. W. was certainly right as to *fact* he was certainly wrong as to *motive*.

We could wish that similar admission, as to facts, had been made by the re-inventors of Hare's Compound blow-pipe and of the jet attached thereto. The second inventors were Mr. Rutter and Prof. Daniell of England.\* B.

*Hancock's Steam Carriage.*—A correspondent of the London Mechanic's Magazine states that the journey from London to Hounslow, the distance being 7½ miles has been performed, going and returning at the rate of about 9½ miles per hour. The stoppages swelled the time of each jaunt to nearly twelve hours.

*Maudesley and Field's Steam Carriage.*—From the same source it appears that the jaunt above referred to has been made by a steam carriage of Maudesley and Field. The rate about ten miles per hour. The time out 8h. 10m. and back in 11h. 22m. including stoppages.

*Experiments for the safety of the Steam Engine.*—Under the act of the 30th of June, 1834, "authorizing the Secretary of the Navy to make experiments for the safety of the steam engine," and appropriating five thousand dollars for that purpose, many proposed improvements have been submitted for the purpose of being tested by experiments. Some of these were so easily tested by those having steam engines in operation, that the aid of Government was not needed: others were attended with greater difficulty, and could not be tested without the expense of constructing boilers and other machinery for the purpose. These proposed improvements have not been such, as in my opinion, to warrant a large expenditure of money; and no experiments have been made upon them. Such experiments, however, would have been made, if they could have been made without the expense of constructing engines.

"The act seemed particularly to require that the steam engine devised by Benjamin Phillips, of Philadelphia, should be examined and tested; and that Mr. Phillips should be employed in making the experiments. Mr. Phillips was therefore employed to construct a model engine, with boilers and other machinery which he deemed necessary for the purpose of testing his improvements, which he brought to this District, where he remained several weeks making his experiments before many members of both Houses of Congress, before the officers of the different Departments, and others.

"I attended very carefully to these experiments; but have not been able to perceive in them any improvements, increasing the safety of the steam engine."—[*Rep. of Sec. of Navy to Congress, 1835*]

*New African Expedition of Discovery.*—This project is to begin the exploration to the south, and to travel northward, by caravan. The district to be explored is that between the termination of Denham and Clapperton's discoveries to the north and Campbell's and others to the south. It comprehends about 30° of latitude. Attempts were making in London to procure subscriptions for the outfit and maintainance of the expedition.

*Undulating Railway.*—Arguments on this subject are still presented both pro and con. A one sided view of it has been taken in this journal, but one which has not been satisfactorily refuted: see the report of R. Stephenson, Jr., vol. xv., p. 1. and an article in vol. xii., 1833.

*Mechanical Knighthood.*—Mr. Stephenson has been appointed a knight of the order of Leopold.

*Cooking by Gas.*—It is stated in the London Mechanics' Magazine, that with no more complex contrivance than a sheet iron cylinder covered with wire gauze, and placed over a gas light, two quarts of water in a common copper tea-kettle may be boiled by the consumption of three cubic feet of

\* See this Journal, vol. xi., p. 149.

gas. The gas issuing from the jet pipe mixes with the air in the cylinder, and the mixture is set fire to above the wire gauze.

*Howard's Quicksilver Engine.*—A trial of this engine, which uses the vapour of mercury as a moving power, is to be made at Lisbon in the steam packet Comet.

*Current through the Straits of Gibraltar.*—A writer in the Nautical Magazine for September, explains thus the current which sets constantly from the Atlantic to the Mediteranean through the straits of Gibraltar. The specific gravity of the water of the Mediterranean has been ascertained to be 1030 while that of the Atlantic is but 1028. The depth between Ceuta and Europa point is 4200 feet. A column of water of the specific gravity of 1030, and of the height of 4200 ft. would balance one of the specific gravity of 1028 and of the height of 4208½. The difference of level of the two seas if a barrier were placed across the surface, and equilibrium produced by pressure on the water below, would be 8½ feet. The waters of the Atlantic tend to press in therefore at the surface, while the denser water of the Mediteranean flows out at the bottom. Observations in proof of such an under current have been made.

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*List of Patents which issued in November, 1835.*

November

682. <i>Prussiates, making and dying with.</i> —Felix Fossard, City of Philadelphia,	7
683. <i>Cutting Straw, &amp;c.</i> —Henry C. Jones, Rochester, Ohio,	7
684. <i>Charcoal Kiln.</i> —E. B. Gilbert, Euphrata, New York,	7
685. <i>Horse Rake.</i> —James Pudney, Stanford, New York,	7
686. <i>Crackers, cutting.</i> —L. P. Clarke, Baltimore, Maryland,	7
687. <i>Cutting Straw.</i> —Ashman Hall, Putnam County, New York,	7
688. <i>Grist Mill.</i> —Philip Hauser, New Haven, Connecticut,	7
689. <i>Rotary Steam Engine.</i> —John G. Hotchkiss, New Haven, Connecticut,	7
690. <i>Smul Machine.</i> —John Tuck, Columbus, Pennsylvania,	7
691. <i>Canal Steam-boat.</i> —John Elgar, Baltimore, Maryland,	7
692. <i>Rail road and Canal Transportation.</i> —John Elgar, Baltimore, Maryland,	7
693. <i>Balance for Counters.</i> —Elias A. Hibberd, Lunenburg, Vermont,	7
694. <i>Tanning, extract of Bark for.</i> —Otis Batchelder, Bedford, New Hampshire,	7
695. <i>Horse Collars.</i> —H. C. Call, Sterling, Connecticut,	14
696. <i>Screen for Grain.</i> —E. P. Fitzpatrick, Mount Morris, New York,	14
697. <i>Anti-friction box.</i> —E. Fisk, and J. C. Green, Fayette, Maine,	14
698. <i>Steam engine, centrifugal.</i> —Charles J. Conway, city of New York,	14
699. <i>Cisterns, &amp;c., water proof.</i> —Levi Kidder, city of New York,	14
700. <i>Anodyne sirop.</i> —Rezin Thompson, Rome, Tennessee,	14
701. <i>Floating dry dock.</i> —Rufus Porter, Bellerica, Massachusetts,	14
702. <i>Smul machine.</i> —E. P. Fitzpatrick, Mount Morris, New York,	14
703. <i>Japan for leather.</i> —William Gates, Hanover, New York,	14
704. <i>Fireplace, &amp;c.</i> —J. Douglass, S. Durham, Maine,	14
705. <i>Truss for hernia.</i> —V. Wilkinson, city of New York,	14
706. <i>Hair, extracting from skins.</i> —Nahum Swett, Readfield, Maine,	14
707. <i>Truss for hernia.</i> —Robert Semple, Vandalia, Louisiana,	14
708. <i>Propelling by screw.</i> —E. P. Fitzpatrick, Mount Morris, New York,	23
709. <i>Cheese press.</i> —W. C. Greenleaf, Andover, Maine,	23
710. <i>Spark catcher.</i> —G. Holbrook, Boston, Massachusetts,	23
711. <i>Feathers, dressing.</i> —B. Smith, Schodack, New York,	23
712. <i>Medicine administered by steam.</i> —Ben. Grut, city of New York,	23
713. <i>Sopha, &amp;c., springs for.</i> —E. Cherrington, Boston, Mass.	23
714. <i>Bedstead and mattress.</i> —E. Charrington, Boston, Mass.	23
715. <i>Rail-roads.</i> —E. Johnson, Rochester, New York,	23
716. <i>Horse shoe machine.</i> —Henry Burden, Troy, New York,	23

717. <i>Spring saddle.</i> —Adam Hickman, Abingdon, Virginia,	23
718. <i>Floating dry dock.</i> —J. R. Campbell, and J. S. Withington, Boston, Mass.,	26
719. <i>Steam boilers.</i> —Thomas Ashcroft, Boston, Mass.	26
720. <i>Chilling castings.</i> —Henry Saunders, Greensburg, New York,	26
721. <i>Mortising machine.</i> —J. M'Bride, Richmond, Indiana,	26
722. <i>Turnabouts for rail-roads.</i> —David Evans, Philadelphia county,	26
723. <i>Canal boat, sheet-iron.</i> —L. Parmelee, Poughkeepsie, New York,	26
724. <i>Spring saddle.</i> —Charles Bates, Staunton, Virginia,	26
725. <i>Water wheel.</i> —Edward Newman, Stilesville, Indiana,	26
726. <i>Asbestos, application of.</i> —John Scott, Philadelphia,	26
727. <i>Sheet-iron fireplace.</i> —Gilbert Richards, Ashfield, Mass.	26
728. <i>Cotton seed huller.</i> —John Ambler, Jr., Philadelphia,	26
729. <i>Hydrant.</i> —Sater T. Walker, Baltimore, Maryland,	26
730. <i>Grist mill.</i> —Samuel Hyde, Malone, New York,	26
731. <i>Saw.</i> —John Ruthven, city of New York,	26
732. <i>Spark catcher.</i> —J. W. Waples, Wilmington, Delaware,	26
733. <i>Cloth winding machine.</i> —J. Goulding, and J. Brackett, Boston, Mass.	26
734. <i>Diving dress.</i> —J. R. Campbell, Boston, Massachusetts,	26
735. <i>Kiln for grain.</i> —Thomas Crook, New Hope, Pennsylvania,	26
736. <i>Hot air hearth.</i> —L. V. Badger, and R. Walker, Portsmouth, N. H.	26
737. <i>Cutting straw.</i> —John Wirt, Evansham, Va.	26

*List of Patents which issued in December, 1835.*

*December*

735. <i>Cupola Furnace.</i> —L. V. Badger, Portsmouth, New Hampshire.	2
736. <i>Pencil and crayon points.</i> —George C. Baldwin, Ticonderoga, N. Y.	2
737. <i>Smoothing metals.</i> —Bradford Seymour, Utica N. Y.	2
738. <i>Rail road car wheels.</i> —Arundius Tiers, Kensington, Penna.	2
739. <i>Sunken vessels, raising.</i> —W. Atkinson and E. Hale, City of New York,	2
740. <i>Water-proof boots.</i> —David Clarkson, City of New York,	2
741. <i>Brakes for cars, &amp;c.</i> —John K. Smith, Port Clinton, Pa.	2
742. <i>Drilling rock.</i> —Aaron Van Cleve, Stonington, Conn.	2
743. <i>Iron pipes, casting.</i> —John D. Morris, Kensington, Pa.	2
744. <i>Cooking stove.</i> —Henry Stanley, Rutland County, Vermont,	2
745. <i>Weaving stock frames.</i> —F. Goodell and T. W. Harvey, Ramapo, N. Y.	2
746. <i>Clover seed, hulling.</i> —George W. Taylor, Bridgetown, N. J.	4
747. <i>Cooking stove.</i> —Bennington Gill, City of N. Y.	9
748. <i>Cutting straw, &amp;c.</i> —Leonard Marsh, Windsor County, Vt.	9
749. <i>Hats, traveling.</i> —V. De Brain, City of N. Y.	9
750. <i>Truss for prolapsus, &amp;c.</i> —John F. Gray, City of N. Y.	15
751. <i>Fire place.</i> —Charles Lane, Hingham, Mass.	15
752. <i>Pressing brick.</i> —Ulysses Ward, Washington City,	15
753. <i>Flour bolt.</i> —Aritus A. Wilder, Mount Morris, N. Y.	15
754. <i>Laths, cutting.</i> —Barnabas Langdon, Troy, N. Y.	15
755. <i>Tobacco press.</i> —John W. Weems, West River, Md.	15
756. <i>Buckwheat, cleaning.</i> —Daniel T. Laning, Cumberland County, N. J.	15
757. <i>Sharpening razors, &amp;c.</i> —William Child, Baltimore, Md.	15
758. <i>Water cistern.</i> —Alfred Palmer, Syracuse, N. Y.	16
759. <i>Lamp.</i> —Cyrus Rust, City of N. Y.	28
760. <i>Door locks.</i> —J. K. & H. C. Campbell, Charleston, Mass.	28
761. <i>Steam gauge.</i> —Samuel Raub, Jr. Wilkesbarre, Pa.	28
762. <i>Thrashing grain.</i> —Moses Davenport, Phillips, Somerset County, Md.	28
763. <i>Cleaning feathers.</i> —Edmund Wood, Owego, Tioga County, N. Y.	28
764. <i>Brick machine.</i> —Benjamin Hamblet, Portland, Me.	28
765. <i>Amalgamating mill.</i> —J. Curtis, N. Y.	28
766. <i>Amalgamating mill.</i> —J. Curtis, N. Y.	28
767. <i>Amalgamating mill.</i> —J. Curtis, N. Y.	28
768. <i>Cam press, &amp;c.</i> —Alonzo S. Grenville, Cambridgeport, Mass.	30
769. <i>Ironing, &amp;c. clothes.</i> —Samuel Swett, Jr. Readfield, Me.	30
770. <i>Thrashing machine.</i> —Amos Hanson, Windham, Me.	30
771. <i>Mowing machine.</i> —A. M. Wilson, Rhinebeck, N. Y.	30
772. <i>Clock escapement.</i> —James Fulton, Shelby County, Ky.	30

## CELESTIAL PHENOMENA, FOR MARCH, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.					
1	7	36	Im. „ Leonis,	,3,4,	N. 73°	V. 25°	
1	8	52	Em.		238°	191°	
4	12	16	N. App. ♀ and γ' Virginis,	,4, ♀	North 2.3		
8	16	26	N. App. ♀ and ζ Ophinchī,	,5, ♀	South 2.5		

## Meteorological Observations for November, 1835.

Moon.	Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
☉	1	37°	46°	30.45	30.30	E.	Moderate.	.16	Clear day.
	2	38	54	.25	1.15	NE.	do.		Lightly cloudy—cloudy.
	3	39	60	.00	.30	W.	do.		Cloudy—lightly cloudy.
	4	50	66	.00	.06	S.	do.		Fog—hazy.
	5	54	61	.00	29.95	SW.	do.		Dense fog—cloudy.
	6	53	52	29.95	.96	SE.	do.		Cloudy—do.
	7	49	57	.85	.85	SE.	do.	.16	Rain—cloudy.
	8	47	59	30.00	30.00	SSE.	do.		Drizzle—cloudy.
	9	53	59	29.80	29.80	SE.	do.	.65	Rain—clear.
	10	42	51	.83	30.00	NW.	do.		Clear—rain in the night.
	11	52	51	.50	29.10	S.	do.	1.02	Rain—flying clouds.
☾	12	38	44	.12	.10	W.	Moderate.		Cloudy—flying clouds.
	13	34	36	.50	.50	W.	do.		Cloudy—clear.
	14	26	45	30.00	30.00	NW.	do.	.10	Clear—lightly cloudy.
	15	42	53	.00	29.98	SE. W.	do.		Cloudy—lightly cloudy—rain.
	16	53	61	29.80	.75	SW.	Calm.	.10	Cloudy—do.
	17	46	48	.80	.80	NW.	Brisk.		Cloudy—do.
	18	44	50	.84	.85	SW.	Moderate.	.10	Cloudy—Aurora Borealis.
	19	46	52	.85	.85	SW.	do.		Cloudy—rain.
	20	50	65	.83	.65	SW.	Calm.		Cloudy—foggy.
☉	21	49	53	.80	.85	W.	Moderate.		Mist—partially cloudy.
	22	37	36	30.20	.80	N.	do.		Cloudy—lightly cloudy.
	23	32	33	.00	.75	NE.	do.	1.15	Snow—drizzle.
	24	35	35	29.80	.95	N.	do.		Sleet—rain.
	25	28	37	30.05	30.12	NW.	do.		Cloudy day.
	26	24	37	.05	.05	W.	do.		Clear—lightly cloudy.
	27	28	35	.09	.06	NE. SW.	do.	.05	Lightly cloudy.
	28	32	38	29.75	29.75	W.	do.		Cloudy—snow.
	29	19	24	.70	.75	W.	do.		Lightly cloudy.
	30	20	35	.85	.76	W.	Brisk.	3.33	Clear day.
	Mean	39.96	44.50	29.88	29.85				Cloudy day.

Thermometer.  
Maximum height during the month, 66. on 4th.  
Minimum do. 19. on 29th.  
Mean do. 44.23

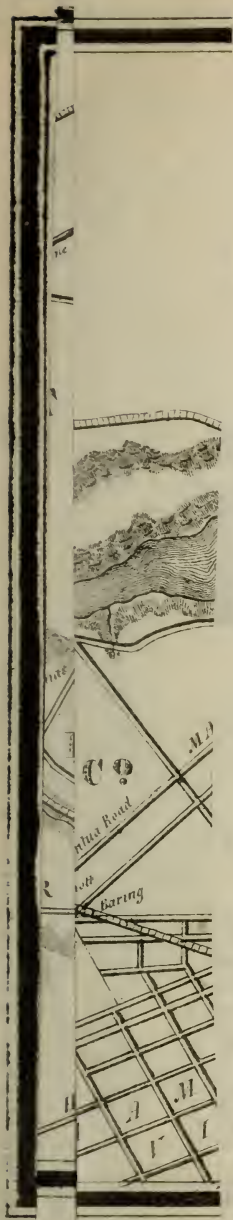
Barometer.  
30.45 on 1st.  
29.10 on 11th & 12th.  
29.86

*Note to Readers.*—In order that the Selections might not be crowded out of the present number, an extra form of twelve pages has been added. The paging is the same as that of the preceding form, with “bis” added.

The report of the Committee on Explosions will be continued in the next number, and concluded in the following one.

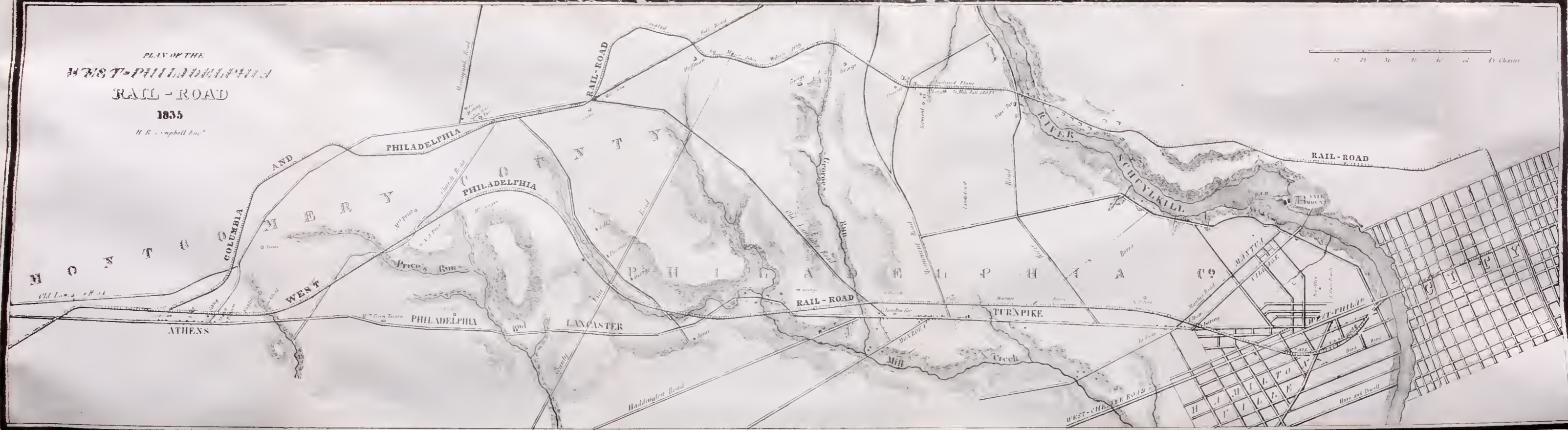
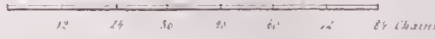
COM. PUB.

*Erratum.*—In the list of patents for 1835, the final number, 772, is correct. The last three numbers for November, and the first three for December, are the same, owing to certain patents having been erroneously marked as issued in the Patent Office.



the dish was clean but the surface not smooth; the second and third, when the dish was free from grease, but much oxidated.

PLAN OF THE  
**WEST-PHILADELPHIA**  
 RAIL-ROAD  
 1835  
*H. B. Campbell Eng.*



**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
Of the State of Pennsylvania,  
AND  
**MECHANICS REGISTER;**  
DEVOTED TO  
**Mechanical & Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

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MARCH, 1836.

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**Practical and Theoretical Mechanics.**

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*Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.*

*(Continued from page 92.)*

The temperature of maximum vaporization was obviously about  $292^{\circ}$  Fah. The effect of the polish was thus distinctly shown by a comparison with the preceding table, which gave  $327\frac{1}{2}^{\circ}$  to  $329\frac{1}{2}^{\circ}$  for the same point. Perfect repulsion took place as low as  $315^{\circ}$  Fah. In repeating this series, with the surface tarnished by the effect of the heat and water used, the temperature of maximum vaporization was raised to  $325\frac{1}{2}^{\circ}$ , and of perfect repulsion to about  $378^{\circ}$ , confirming the conclusions from the preceding series.

3. The same copper bowl in a bath of oil, the surface being clean but not smooth; and again, the surface being very much oxidated, but free from grease, gave the results recorded in the next table. The nature of the bath would not, probably, materially affect the results with so small a quantity of water; the cooling effects, of the vaporization of the drop, upon the surface of the metal being inconsiderable. In these rough surfaces the effect of giving a tendency to motion to the drop of water, by allowing it to fall on the sides of the bowl, becomes very appreciable. This tendency assists the force of repulsion, and frequently determines a considerable increase in the time of vaporization.

The first series in the annexed table, consists of results obtained when the dish was clean but the surface not smooth; the second and third, when the dish was free from grease, but much oxidated.

Fah.°	Surface clean.				Surface oxidized.				Surface oxidized.			
	Descending Series.				Descending Series.				Ascending Series.			
	Side drops.		Centre drops.		Side drops.		Centre drops.		Side drops.		Centre drops.	
	Time in sec's.	Remarks.	Time in sec's.	Remarks.	Time in sec's.	Remarks.	Time in sec's.	Remarks.	Time in sec's.	Remarks.	Time in sec's.	Remarks.
283.5	1	-	$1\frac{1}{2}$	-	-	-	$>\frac{1}{2}$	-	-	-	3	-
290.6	-	-	$>1$	Nearly.	-	-	-	-	-	-	-	-
292.6	-	-	$1\frac{1}{4}$	-	-	-	-	-	-	-	-	-
294.7	-	-	$\frac{3}{4}$	-	-	-	-	-	-	-	-	-
296.7	-	-	$\frac{2}{4}$	-	-	-	-	-	-	-	-	-
298.8	-	-	$<1$	Very small drops are still repelled.	-	-	-	-	-	-	-	-
300.9	-	-	-	-	-	-	-	-	-	-	-	-
302.9	-	-	-	-	-	-	-	-	-	-	-	-
305.0	-	-	1	Small drops rep'd.	-	-	$\frac{1}{2}$	About.	-	-	$2\frac{1}{2}$	-
309.2	-	-	-	-	-	-	$>\frac{1}{2}$	-	-	-	2	-
311.2	-	-	$1\frac{1}{2}$	-	-	-	-	-	-	-	-	-
313.2	-	-	2	-	Still repelled.	-	$\frac{1}{2} & \frac{1}{4}$	-	-	-	$1\frac{1}{2}$	-
315.3	-	-	-	-	-	-	$\frac{1}{4}$	-	-	-	1	-
317.3	-	-	-	Diff't parts of the dish repel uneq.	-	-	-	-	-	-	-	-
319.3	-	-	-	-	-	-	$\frac{1}{2} & \frac{1}{4}$	-	-	-	-	-
321.4	-	-	-	-	-	-	-	-	-	-	$<1$	-
323.4	-	-	-	-	-	-	-	-	-	-	-	-
325.4	-	-	-	Not perfectly rep.	Repelled.	-	$<\frac{1}{2}$	-	-	-	-	-
327.5	-	-	-	-	-	-	-	Not repelled.	-	-	$\frac{3}{4}$	-
329.5	-	-	-	-	-	-	-	-	-	-	$\frac{1}{2}$	-
331.5	-	-	-	-	-	-	5	-	-	-	$>\frac{1}{2}$	-
333.6	-	-	-	-	-	-	-	-	-	-	$<\frac{1}{2}$	-
335.6	-	-	-	-	-	-	$3\frac{1}{2}$	-	-	-	-	-
337.6	-	-	-	-	-	-	$4\frac{1}{2} & 2\frac{1}{2}$	Perfectly repelled	$\frac{1}{4} & \frac{1}{2}$	-	$1\frac{1}{2} & \frac{1}{4}$	-
339.7	-	-	-	-	-	-	-	-	-	-	$\frac{1}{4} & \frac{1}{2}$	-
341.7	-	-	-	-	-	-	4	Not perfect.	$>\frac{1}{2}$	-	-	-
343.8	-	-	-	-	-	-	-	-	-	-	-	-
345.9	-	-	-	-	-	-	-	-	-	-	-	-
348.0	-	-	-	-	-	-	-	-	-	-	-	-
350.0	-	-	-	-	-	-	-	-	-	-	$\frac{1}{4}$	-
362.3	-	-	-	-	-	-	-	-	-	-	1	-
366.4	-	-	-	-	-	-	-	-	-	-	$1\frac{1}{2}$	-

Just repelled.

The point of maximum vaporization which, with the clean surface, was between  $294^{\circ}$  and  $299^{\circ}$ , was raised by oxidation to  $317\frac{1}{2}^{\circ}$ , and by an increase in the roughness of the surface to about  $348^{\circ}$ .

*Comparison of Results for Copper.*

4. A comparison of the results thus obtained for the vaporization from the surface of copper .07 inch thick, under different circumstances, are contained in the following table; which indicates also, pretty nearly, the relative times of vaporization of the same very small quantity of water under these circumstances.

The temperature of the liquid drops, and the pressure under which they were vaporized, are elements which, of course, it is unnecessary to consider, although it was deemed safer to enter them upon the original notes than to omit to notice them.

Nature of Surface.	Temperature of maximum vaporization.	Time of Vaporizat'n.	Temp. of Repuls.
	Fah. $^{\circ}$	Seconds.	Fah. $^{\circ}$
Surface highly polished,	292	3	315
„ tarnished,	325 $\frac{1}{2}$	<1	
„ polished,	328 $\frac{1}{2}$	2 & 1 $\frac{1}{2}$	350
„ rough but clean,	296 $\frac{1}{2}$	$\frac{3}{4}$	
„ oxidized,	317 $\frac{1}{2}$	$\frac{1}{4}$	338
„ very much oxidized and not clean,	348	$\frac{1}{4}$	

The results thus compared, are probably as accordant as ought to be expected, and indicate the effect of smoothness of surface to be to lower the temperature of maximum vaporization, but to increase the time required to vaporize at that temperature. Thus in the two extremes of high polish and considerable oxidation, the temperatures of maximum vaporization are  $292^{\circ}$  and  $348^{\circ}$ ; and the times of vaporization 3 seconds and  $\frac{1}{4}$  of a second. The nearness of the point of repulsion to the temperature of maximum vaporization is shown in those cases where the point at which perfect repulsion took place, was noted, nearly; the temperature exceeds that of maximum vaporization by about twenty-one degrees.

*Vaporization of Drops of Water by Iron.*

5. Experiments were also made to determine the temperature of maximum vaporization of water by iron with different states of surface, and as they preceded those made with the copper, the number of series was more considerable, that care might in a measure supply the place of experience. It will be wholly unnecessary to give the details of each series, since the mode of experimenting has already been stated, and the results can alone be of interest. At the same time, the temperature at which perfect repulsion of the drops took place, was observed. A portion of the experiments were made in an oil bath, others by communicating the heat through tin.

In the following table are the results for a bowl of wrought iron, (No. III,) three-sixteenths of an inch thick; the surface was cleaned with acid and alkali, after each series: it was not very different in smoothness in the different series, until the closing one, which is marked in the table. The oil bath was used in these experiments. The drops of water were let fall from a dropping tube, and one hundred and twenty-eight were required to make one-eighth of a fluid ounce; each drop, therefore, weighed about .45 of a grain.

Temperature of maximum vaporization, and of perfect repulsion, of drops of water let fall upon the sides of an iron bowl, three-sixteenths of an inch thick.				
No. of Series.	Surface clean.			
	Temp. of max. vap.		Repul- sion.	Remarks.
	Extremes.	Mean.		
First series, ascending			382½	Maximum vaporization passed, at 336½°. Repulsion not perfect at 378½°.
Second series, descending	331½ a 334½	333	373½	Repulsion not perfect at 370½°.
Third series, ascending			386½	„ „ at 385°.
Fourth series, descending	337½ a 341	339	382	„ „ at 378½°.
Fifth series, ascending	327½ a 331½	329½	390	„ „ at 389°.
Mean		333.8	382.9	
	Surface oxidated from use in the foregoing.			
Sixth series, ascending	343 a 350	346½	385	Drop breaks on irregular parts of bowl even at this point, i. e. repulsion not perfect.

The column of remarks in the foregoing table, is intended to contain principally the temperatures at which the repulsion was observed not to be perfect, and gives an idea of the approximation to the true point of repulsion which each individual observation affords. These numbers obviously differ from those for the temperatures of perfect repulsion, less than these latter among themselves, and much less than might have been expected, from the uncertain nature of the effect of slight inequalities of surface.

6. The following table contains another series of results with a thicker iron; they show that the cooling effect in the series just given, was imperceptible, no change in the position of the point of maximum vaporization having been produced by the increase of thickness, that is, by substituting a metal as the source of the communicated heat for an equal thickness of oil. This bowl was very highly heated after the first experiment, so as to cover its surface with a scale of oxide, and the results accord entirely with the similar ones already given, the temperature of maximum vaporization being raised.

Vaporization of water by an Iron bowl one-fourth of an inch thick. Surface cleaned with acid and with alkali.			
Temp. of max. vaporizat'n.		Temp. of repulsion.	
Side drops.	Centre.	Side.	Centre.
337½	358	405	
Scale of oxide by high heat.			
381½		433	456½

In the only other series of experiments with which the committee are acquainted, and which have been directed to the same point, those of Professor Johnson, the point of maximum vaporization is placed at between 304° and 320° Fah. The different nature of the surfaces employed may perhaps account for the difference of this result from that of the committee.

7. The repulsion as developed in solid tin, when heated, was made out from the experiments given below. The figure of the surface of tin was that of the under side of bowl No. VIII. viz. a portion of a spheroid nearly coinciding with a sphere of 3.35 inches radius; the surface itself was tolerably smooth, conforming to the exterior of the iron bowl; there were, however, small irregularities in it.

Table showing the Temperature of Maximum Vaporization for Tin. Surface slightly corrugated.

Centre drops.		Remarks.
Temperature.	Time in Secs.	
276½	1½	Side drops not repelled.
302		
a	¾	
321½		
338		
a	½	Ten drops in six seconds. Side drops repelled. Maximum vaporization.
364½		
379	< ½	
393	.6	
409½	.5	
419½	.45	
426	.5	
430	.56	
444	.6	
454	1.5	
		Tin not melted at surface, though the thermometer is 14° above its melting point below. Thermometer has been compared by the test of melting tin.

The experiments which follow the remark, "ten drops in six seconds," were all made by dropping several drops, not enough however to cool the surface down; measuring the time for the whole number, and dividing by that number. The point of maximum vaporization is placed, with probability, at  $419^{\circ}$ , the times had certainly increased in rising to  $444$ , but in descending, the same certainty is to be found only on reaching  $321\frac{1}{2}^{\circ}$ . This slightly rough but polished surface, as it may be considered, had its temperature of maximum vaporization very certainly above that of the polished copper and of the smooth iron. The time of vaporization of a drop at this temperature was less than one-sixth of the corresponding time for the polished copper, and less than that for the clean copper surface; agreeing more nearly with that for the smooth iron, which was much its inferior in lustre. A correct induction could only be had by varying the number of metals, and by frequent repetition of the results, but so far as these experiments go, they indicate that this repulsion does not depend alone upon the relative polish of the different metallic surfaces.

8. The conclusions which they fairly warrant, are as follows:

1st. With the same metal, the temperature of maximum vaporization of water is lower, as the smoothness of the surface is greater, and the amount of vaporization in a given time at this temperature, is much diminished. In copper, the effect of polish and of oxidation, the two extremes, is shown by a difference in the temperature of maximum vaporization, of 56 degrees, that point being in the two cases,  $292$  and  $348^{\circ}$ . Further, the ratio in the times of vaporization at these two points, is as twelve to one, or for the same drop of water, 3 seconds and  $\frac{1}{4}$  of a second. In iron, the smooth surface gave, for the temperature of maximum vaporization,  $334$ , or  $337\frac{1}{2}^{\circ}$ , the oxidated  $346\frac{1}{2}^{\circ}$ , differing but little from the former; but when highly oxidated, gave  $381$ , or a difference of about  $45^{\circ}$ , the time of vaporization not differing greatly in the two cases.

2d. The temperatures of maximum vaporization for copper and iron, in similar states of surface, differ between thirty and forty degrees, the iron having the higher point. The time of vaporization at the maximum, is less in the copper than in the iron, in the ratio, probably, of two to one, or nearly in the ratio of their conducting powers for heat, which are as two and a half to one.

3d. The temperature of maximum vaporization, for oxidated iron, or for highly oxidated copper, corresponds nearly to that at which steam has an elastic force of nine atmospheres. But the vapour was formed under atmospheric pressure only.

4th. A repulsion between the metal and water is perfect at from twenty to forty degrees above the point of maximum vaporization, following more closely upon the temperature of maximum vaporization in copper than in iron. At these temperatures, the water does not wet the metal. The drops of water are put in rotary motion in variable directions, and sometimes remain at rest, slowly vaporizing. When very small, they sometimes leap vertically from the surface of the metal. They seem to vaporize from the side next to the metal.

A general view of the facts just deduced, is given numerically, in the following table.

Table showing the Temperature of Maximum Vaporization of Drops of Water in Copper and Iron Bowls.

Nature of the Surface.	COPPER .07 inch in thickness.			IRON 3-16ths inch thick.      ½ inch thick.			
	Temp. of max. vap.	Time in seconds.	Temp. of repuls'n.	Temp. of max. vap.	Temp. of repuls'n.	Temp. of max. vap.	Temp. of repuls'n.
Highly polished	292°	3	315				
Clean, not polished	296½	¾		334*	383	337½	405
Oxidated	321	½		346½†	385		
Highly oxidated, } and not clean }	348	¼	338				
Ditto, but clean						381	433

\* Mean of three series. Time between 1 sec. and 1½ seconds.

† Time about 1 second for .45 gr. of water.

There can be no doubt that, at the temperatures determined as those of maximum vaporization, an effective force of repulsion between the heated metal and the water has begun to be developed. For we may assume that heat will tend to pass from the metal to the water the more rapidly as the temperature of the former exceeds that of the latter, which would tend to increase the vaporization after the repulsive action had commenced.

The temperatures of maximum vaporization are reached in practice in the high pressure steam engines. The locomotives with flues of copper, use steam of sixty pounds pressure upon the safety valve, corresponding to nearly 306° Fah.; a temperature which is but fifteen degrees below that found for the maximum vaporization by oxidated copper. The iron boilers of our high pressure engines use steam of from ten to eleven atmospheres, or from 354° to 360° Fah., the higher temperature being about twenty degrees below the temperature found for the maximum vaporization of water by an oxidated surface of thick iron.

It is possible, and indeed probable, that pressure may modify these results, all of which were obtained under atmospheric pressure. Pressure, tending to counteract the effect of the repulsion between the heated metal and water, would probably raise the temperature of most rapid vaporization.

#### *Vaporization of considerable quantities of Water.*

9. The results already presented, however interesting they may be in a practical or in a philosophical point of view, cannot be said to touch the question of the effect of the contact of water suddenly made with hot metal, in producing explosions. It is necessary to suppose so large a quantity of water, brought under the vaporizing influence of the metal as, except where there is a violent repulsion by the heated metal, to reduce materially the temperature of the surface. To study the question in this point of view, we must ascertain, if possible, the law, according to which a variable quantity of water, thrown upon heated metal, is capable of reducing its temperature, so as to produce the maximum amount of vaporization. That such a maximum may be

found, will be seen by considering the foregoing results. They show that an effective repulsion is developed between water and heated metal, increasing rapidly after a certain temperature, at which the vaporization is a maximum. Now water thrown upon a surface at its temperature of maximum vaporization, would cool it down rapidly below this temperature. Again, if thrown upon it at a temperature when the repulsive effect was very strong, it would not be able to cool it down as low as the temperature of maximum vaporization. Somewhere, then, between the points thus referred to, there will be an initial temperature, at which the vaporization will be the greatest possible, or a given quantity of water will be vaporized in the least time. It is obviously not as easy to solve this problem as the preceding one, nor can so satisfactory results be expected, nor results so constantly reproducible; its practical importance required that its solution should be attempted; and the method adopted was as follows. The same baths, viz. oil and tin, were used as in the foregoing series, to ascertain, generally, the effect of communicating heat through different media. Different metals, copper and iron, with different thicknesses of each, and different states of surface, were subjected to trial. The quantity of water was gradually increased, from small quantities, scarcely capable of reducing the temperature of the surface when the repulsive tendency was fully developed, to quantities as considerable as the bowls could contain. The study of each case was of course attended with much labour. In the greater quantities of water the temperature of the metal of the dishes was so much reduced as to affect that of the bath itself. Accordingly a mean of the temperatures, observed at regular intervals, is taken as the temperature of the bath on which the water was thrown, and which, taking the entire mass into consideration, was supplying an amount of heat due to that temperature, to the parts adjacent to the bowls. The oil bath was stirred to produce as nearly as practicable, a uniformity in temperature in the different parts.

Without knowing the temperature to which the parts of the heated metal, or of its bath, are reduced by the affusion of water, this kind of experiment supplies precisely the answer to the question in practice; *at what temperature of a metal will water, thrown upon it in a limited quantity, be most rapidly turned into steam?* Making due allowance for the different modes of communicating heat in the experiments and in practice.

### Copper Bowl, No. VII.

10. The same bowl used in a former series of experiments was again applied, the surface being smooth. This bowl was a portion of a spheroid, approaching nearly, in its inner surface, to a spherical surface of 3.09 inches radius: the versed sine of the segment, or depth of the bowl, was 1.6 inches and its chord, or the breadth of the bowl 5.39 inches. The thickness of the metal was .07 of an inch.

The quantity of water first introduced was  $\frac{1}{8}$ th of an ounce by weight (60 grains troy,) the water being weighed in a small metallic dish, and thrown into the bowl, placed in the bath. One experimenter observed the temperature of the bath, and gave notice to another of the instant of introducing the water; the other made a memorandum of the temperature and time. The first observer gave notice of the instant at which the liquid began to boil, which was also entered upon the notes. The second then announced each minute, or half minute, as it passed, and the first gave the temperature of the bath at that time, stating also the circumstances taking place in the bowl, when remarkable. The same observer also gave warning when the liquid was about to disappear,

and a signal at the instant of its disappearance, which was marked by the second. The time between the introduction of the liquid into the bowl and its beginning to boil is deducted in each case in the following tables, so that they show the times necessary to vaporize the water, after it had been raised to the boiling point. At the high temperatures, the time required to raise the smaller quantities of water to ebullition, scarcely amounted to half a second. The times were noted, usually, by a pendulum beating seconds, sometimes by a quarter-second pendulum.

When a decided repulsion has commenced with these considerable quantities of water, the phenomena are of a very singular kind. The water assumes a rotary motion about an axis perpendicular, or nearly so, to the lowest point of the dish, and at the same time its figure changes, and from being circular in its horizontal section, becomes of an irregular oval, which contracts and dilates alternately as the mass revolves; the transverse axis contracting until its place is occupied by the conjugate, and vice versa. The direction of this rotation is not at all uniform, and the mass sometimes becomes quiescent, and then assumes motion in an opposite direction. When this state of things first begins, vapour sometimes bubbles or bursts up, through the liquid; but when fully established it is most copiously given off from below. In fact, the appearance is that of a stratum of vapour, between the water and the bowl, which becomes, at times, visible, when condensed at the edges.

If the results of the vaporization of one-eighth of an ounce of water, in bowl No. VII. be taken, and a curve be traced from them, of which the ordinates represent the differences between the times of evaporation and a constant quantity, and the abscissæ the differences between the temperatures and a constant quantity, a remarkable regularity will be found in the results, and an approach to a minimum in the time of vaporization. This affords good grounds for attempting to calculate the temperature at which the maximum vaporization, with this quantity of water, would have taken place; or the temperature above which the water introduced would not be able to cool the bowl as low as the temperature of maximum vaporization for drops of water. The obvious approximation of the curve just referred to, see Plate 5, Fig. 1, to the ellipse, induced the trial of the equation of that curve to represent the observations. The following table shows the results of the comparison of calculation and observation, the transverse of the ellipse being assumed equal to  $262^{\circ}$ , and the conjugate to 200 seconds, and the co-ordinates of the centre being  $576^{\circ}$  and 211.5 seconds.\*

\* That is, in the equation  $A^2y^2 + B^2x^2 = A^2, B^2$ ;  $A = 262^{\circ}$  and  $B = 200$  seconds.  $X = 576^{\circ}$ , and  $Y = 211.5$  seconds, are the co-ordinates of the centre. So that  $x = 576^{\circ}$  — the observed temperature, and  $y = 211.5$  seconds — the observed time of vaporization.

No. of Experiment.	Observed Temperature of Vap'n.	Observed Time of Vap'n.	Ordinates from Observation.	Calculated Ordinates.	Difference.
	Fah.°	Seconds.	Seconds.	Seconds.	Seconds.
1	349.5	116.5	95.	100.1	+ 5.1
2	384.	71.	140.5	135.4	— 5.1
3	420.5	46.	165.5	160.3	+ 5.2
4	452.	32.5	179.	175.4	— 3.6
5	486.	22.	189.5	187.	— 2.5
6	508.	18.	193.5	192.3	— 1.2
7	526.	15.5	196.	195.4	— 0.6
8	537.5	15.3	196.2	196.8	+ 0.6
9	558.	14.7	196.8	198.6	+ 1.8
10	568.	13.	198.5	198.9	+ 0.4

A similar comparison which addresses itself, even more directly to the eye, is given in Fig. 1, Plate 5, in which the upper dotted line is that traced from the observations, and the full line is the ellipse which has been assumed.

The general coincidence of these lines, varying only when the observations are indicated, by the nature of the dotted line, to have been irregular, or the near coincidence of the calculated and observed numbers in the table, and the variable sign of the differences, justify us in assuming the true maximum of vaporization at the temperature corresponding to the highest point of the ellipse; namely, to 576° Fah.

At about 576° Fah. then, a bowl of copper .07 of an inch thick supplied with heat by a medium like oil, would be able so far to resist the cooling action of 60 grs. of water, as to produce the most rapid vaporization; the quantity being sufficient to cover about one-tenth of the surface exposed to heat.

#### *Copper Bowl, No. IV.*

11. This bowl was thinner than the last, its thickness being .05 of an inch. Its figure within, approached nearly to a sphere of 3.1 inches radius, the chord of the segment being 5.25 inches, and the versed sine 1.45 inch; it deviated as little, therefore, from the figure of the last as could have been expected from the mode of forming it.

Nine observations were made of the vaporization of  $\frac{1}{8}$ th of an ounce of water in this bowl, placed in a bath of oil. Of these, seven are shown in the middle dotted line of Fig. 1, Plate 5, and agree very well with the ellipse traced in the full line; the two omitted were at temperatures lower than that of the lowest of the seven included in the figure. The following table shows the comparison of calculation and observation, assuming the major and minor axes of the ellipse to be respectively 251° and 214 seconds; and the co-ordinates of the centre 576° and 254 seconds. These values were not obtained rigidly, but they agreed better than numbers, greater and less, which were also tried.

No. of Observation.	Temp. of Vaporization.	Time of Vaporization.	Observed Ordinates.	Calculated Ordinates.	Difference.
	Fah.°	Seconds.	Seconds.	Seconds.	Seconds.
3	352	164	90	96.6	+ 6.6
4	382.5	118	136	136.3	+ 0.3
5	433	78	176	176.0	+ 0.0
6	464.5	62	192	191.8	- 0.2
7	491	54	200	201.1	+ 1.1
8	511	48.5	205.5	206.7	+ 1.2
9	527	43	211	210	- 1.0

The temperature producing the greatest vaporization with 60 grs. of water in a copper bowl .05 inch thick, would be nearly 576° Fah., or about the same temperature as with the greater thickness of .07 inches. The surfaces were nearly alike in the two cases, and both were clean but not polished.

### Bowl, No. I.

12. Was thinner than either of the foregoing; its thickness being only .025 of an inch. The figure was nearly the same as the foregoing, and the quantity of water used and nature of the bath were the same.

Of eight observations made and recorded in the following table, five only appear to belong to the same curve; this is seen in the lowest curve, Plate 5, Fig. 1, in which the dotted line represents the curve of observation. These five may be represented by a circle determined from observations 3, 4, and 8, which give for the radius 262. The co-ordinates of the centre are 604° and 309 seconds.

No. of Observation.	Temp. of Vaporization.	Time of Vaporization.	No. of Observation.	Temp. of Vaporization.	Time of Vaporization.
	Fah.°	Seconds.		Fah.°	Seconds.
1	306.5	397	5	422	118.5
2	319	369	6	452.5	101
3	354	237	7	483.5	76
4	387	163.5	8	505	67

The calculations place the maximum of vaporization about 604° Fah., or 28° higher than the temperature shown by the other bowls, an effect due, of course, to the thinness of the metal of this bowl.

*Vaporization in Iron Bowls.*

13. Similar experiments were made with iron bowls of different thicknesses; No. V. .04 inch, No. II. .08 inch, No. VI. .18 inch, and No. III. of an intermediate thickness between Nos. II. and VI. The curvatures and general dimensions were intended to be those of the copper bowls, from which they in reality differed in no important particular. The radius of No. V. was 3.25 inches, of No. II. 3.1 inches, of No. VI. 2.9 inches; the chord of No. V. 5.2 inches, of No. II. 5.2 inches, of No. VI. 5.2 inches, the versed sine of No. V. 1.3 inches, of No. II. 1.45 inches, of No. VI. 1.6 inches. The difficulty of producing a uniform surface, and of retaining one of any smoothness, for a considerable time made these experiments much less satisfactory than those on the copper; in those with No. V. and No. II. oil obtained access to the cup and vitiated part of the results, and this was also the case at high temperatures with No. I. Small particles of water being thrown out of the dish, sunk below the oil without evaporating, and then in passing into vapour below the surface, threw up the oil with slight explosions. The surfaces were rough but clean, the quantity of water used  $\frac{1}{8}$  oz. troy. The curves representing these observations are shown in Plate 6; and through the striking irregularities in the three lower ones, we see the effect of thickness of metal in increasing the amount of vaporization at a given temperature, the curve of No. III. being higher than that of No. II. and of No. II. higher than that of No. V. and we also see a tendency towards a maximum lying above  $540^{\circ}$  Fah., though, from No. III. and No. V. obviously not far above it. The difficulty of passing the maximum with these thin bowls consisted chiefly in the acrid nature of the vapour given out by the oil, which acting powerfully on the eyes, rendered accuracy extremely difficult, and the effort sustained very painful.

With bowl No. VI. greater pains were taken to smooth the surface, and this was cleaned with alkali, to free it from grease, and then with very dilute acid, which was washed off. The curve given to represent the observations, is altogether more regular than in the other cases, and the maximum was reached between  $503^{\circ}$  and  $512^{\circ}$  Fah., much lower than the corresponding point for the thin iron bowls.

If the vaporization by the copper bowl, No. VII. .07 inches thick, be compared with that of No. II. of iron .08 inch thick, it will be found to be much more considerable. In fact the curve traced for the copper bowl is exterior to the curve for No. III. and at the temperature of about  $540^{\circ}$  Fah. intersects that for the iron bowl No. VI. .18 inch thick. From  $350^{\circ}$  up to  $508^{\circ}$ , the time of vaporization in the copper bowl varies from  $\frac{2}{3}$ ths of that in the iron bowl of the same thickness, to  $\frac{3}{4}$ ths of the time, at corresponding temperatures. The specific heat of the iron, being slightly higher than that of the copper, bulk for bulk, would tend to keep up the temperature of the former metal, but the conducting power of the copper being more than double that of the iron, would much more than compensate for its lower specific heat.

14. The effect of a surface covered with a thick coating or scale of oxide, may be seen by comparing the dotted line near the full line for bowl No. VI. with the full line. At temperatures below  $390^{\circ}$  Fah. the scale of oxide diminishes the vaporization considerably, probably by intercepting heat; but when repulsion begins to be developed, the scale acts to prevent it, and thus to raise the temperature of greatest vaporization, and to diminish the time required for vaporization at a given temperature. It will be recollected that this temperature, of  $390^{\circ}$ , differs but seven degrees from that found for the maximum vaporization of drops from an oxidated surface.

This circumstance will be recurred to again.

Quantities of fluid, varying from  $\frac{1}{16}$ th up to  $\frac{1}{4}$ th of an ounce troy, were now used with a view to ascertain the effect of varying the quantity upon the temperature of maximum vaporization. The surfaces were varied also. The results are given in the following table.

Times of vaporization, at different temperatures, of different quantities of water in bowl No. VI., three-sixteenths of an inch thick, in an oil bath.						
Temperature. Fah.°	One-sixteenth ounce. Time in seconds.		One-eighth ounce. Time in seconds.		One-fourth ounce. Time in seconds.	
	Smooth.	Rough.	Smooth.	Rough.	Smooth.	Rough.
323						231
324	50					
325					234	
326		69	120	134		
353						134
354	23		53	68	127	
356		28½				
357	11					
386		10½	29	29		75
387					78	
388						
389						
390						
419	9		20	22		
420		7½				
423						46
425					46	
427					38	38
450						
452	8					
453		7	18			
454						
455				15		
460						33
461						22
485	8		14			
486		7		10		
489					26	
492					24	
502			13			
503			13 } M			
504	7 M*					
508		4 M				
511			13			
512				9		13 M
516					20	
517	8					15
527					20	
529						
534		5				
538	9				19 M?	
544			15	8 M?		
546						
548						15

\* The letter M designates the temperature of maximum vaporization.

An examination of this table shows no *proper maxima* of vaporization; the differences in the times between experiments near the points of most rapid vaporization being too considerable to indicate a true maximum in any case. Comparing, however, the temperatures of most rapid vaporization as given by the table, for different quantities of water, we observe that the temperature of the metal, when water was thrown upon it, corresponding to most rapid vaporization, which, with  $\frac{1}{16}$ th of an ounce of water, was about  $504^{\circ}$ , was, with  $\frac{1}{8}$ th of an ounce, about  $507\frac{1}{2}^{\circ}$ , and with  $\frac{1}{4}$ th about  $517^{\circ}$ , having been raised but thirteen degrees by quadrupling the quantity of water, while the extent of surface of the metal directly in contact with the water was doubled. At these points, in fact, the repulsion between the metal and water was considerable on first projecting both the sixteenth and eighth of an ounce of water into the bowl.

The effect of roughness of surface is to be seen in the three series; the effect at the lower temperatures seems to be generally to diminish the amount of vaporization; and when repulsion would have taken place had the surface remained smooth to accelerate vaporization at a given temperature, raising the point of greatest vaporization on the scale. If this speculation be admitted, the temperature at which the rough and smooth surfaces vaporize equally, is but little above that of the real maximum of vaporization of the metal when the cooling effect of the water is supposed to be entirely destroyed; that is, when the water is thrown upon it by small drops.

A comparison of the first and second series, would place this point at about  $386^{\circ}$  Fah., the third and fourth, at about  $388\frac{1}{2}^{\circ}$ . The fifth and sixth would leave a doubt of its position, placing it by the nearest of two results at about  $424^{\circ}$ ; while, on the other hand, the near approach at a lower temperature would incline us to make the coincidence conform more nearly to the numbers given by the other series, by selecting two less accordant times, at about  $388^{\circ}$  Fah.

The experiments on drops of water placed the temperature of maximum vaporization in this same bowl at  $334^{\circ}$  Fah. when the surface was smooth, and at  $346\frac{1}{2}$  when rough, no doubt a nearer approximation to the real point of maximum vaporization than that just deduced by the medium of a considerable quantity of fluid.

15. No satisfactory method occurred of ascertaining the temperature of a small portion of a piece of metal of the thickness used in steam boilers and exposed to the action of water, at or below the boiling point, while it received heat from a constant source. It was deemed advisable, therefore, to compare the effects which would be produced by communicating heat through a very good conductor, such as tin in the solid or liquid state, and through an imperfect conductor and circulator, like the thickened oil employed in the foregoing series.

The same bowl was therefore tried in tin and in oil, with the same quantity of water, and with the following results, the bowl being .25 inch thick, (No. VIII.) and the material iron. The curves of observation are traced on Fig. 2, Plate 6.

Table of the times of Vaporization in different Baths.

Temperature.	One-eighth ounce. Time in seconds.		Remarks.
	Tin.	Oil.	
455	8 $\frac{1}{4}$	16	Bowl, No. VIII., $\frac{1}{4}$ inch thick.
465		12 $\frac{1}{2}$	
473	7 $\frac{1}{4}$		
481		11 $\frac{1}{4}$	
491	6 $\frac{1}{4}$		
502		10 $\frac{1}{2}$	
504	6		
513	6	10 $\frac{1}{2}$	
521		10 $\frac{1}{2}$	
537		10 $\frac{1}{4}$	
539	6 $\frac{1}{4}$		
555		9 $\frac{1}{4}$	
559	6 $\frac{7}{8}$		
567	15 $\frac{1}{2}$		
568		9 $\frac{1}{2}$	
591	16		

The irregularity of the series made with the oil bath, throws a doubt upon the maximum obtained, particularly as, with a thinner vessel, the preceding series gives a lower temperature as that of most rapid vaporization, and the recurrence of the same time during a range of nineteen degrees, confirms this doubt.

The temperature of greatest vaporization in the tin was about  $508\frac{1}{2}^{\circ}$  and the time but six seconds, while with the oil it was nine and a quarter seconds, as shown in this series, and probably less than eight, as shown in a foregoing series. The temperature of maximum vaporization here given for the oil bath, is  $555^{\circ}$ , differing  $46\frac{1}{2}^{\circ}$  from that for the tin. Somewhere between  $559^{\circ}$  and  $568^{\circ}$  the times of vaporization are the same for each bath, the repulsion due to the greater heat communicated by the tin counterbalancing the diminished vaporization from the less heat given by the oil.

This comparison shows that the thickness of metal at which the effect of the material of the bath, or means of applying heat, would vanish, is by no means reached in practice.

16. With a less thickness of metal, this difference in the nature of the bath was of course more striking. In a dish, one-twelfth of an inch in thickness, the vaporization, in a bath of tin, compared with a series made with the same surface, in an oil bath, was as follows:

Iron Bowl No. II., 1-12th inch thick. 1-8th oz. water.			
Surface rough.			
In Tin.		In Oil.	
Tem- perature.	Time in Seconds.	Tem- perature.	Time in Seconds.
446°	7½	421°	71
460½	6	452	57
484	6¾	487	51
500	6½	507	47
554	8	517	44
566	8		

The average time of vaporization in the oil bath is rather more than eight times that in the tin.

These experiments, therefore, do not entirely represent the case in practice where heat is communicated by flame, by contact of heated air, and by direct radiation.

The maximum shown by this table lies certainly between  $460\frac{1}{2}^{\circ}$  and  $500^{\circ}$ ; the apparent maximum being at  $460\frac{1}{2}^{\circ}$ , the maximum given, by omitting the observation at  $484^{\circ}$ , being about  $468^{\circ}$ ; and that by omitting the observation at  $460\frac{1}{2}^{\circ}$ , being about  $500^{\circ}$ .

The minimum time for the oil bath is obviously not reached; it will be recollected that this is probably as high as  $570^{\circ}$ , or about fifty degrees higher than the last observation in the table.

The times of vaporization for the tin bath, are nearly the same as those for the bowl of  $\frac{3}{16}$ ths of an inch thick. In fact the heat may be considered as passing through a very thick tin bowl, to the iron, and kept up by flame beneath a second iron surface; the modifying effect of an additional thickness of the iron bowl is therefore small.

### *Vaporization of increased quantities of Water.*

17. It was now an object to increase the quantity of water introduced into the thickest of the iron and copper bowls until the limit of their respective capacities was reached, so that each part of the bowl to which the heat was applied should have also the cooling effects of the water upon it; the effects of the contact of a large quantity of water with hot metal would be thus represented. The nature of the results could not be expected to be otherwise than general.

For reasons already stated, the tin bath was used to communicate heat, and the projection of small particles of water from the dish was avoided by a rim of tin, which gave free escape to the steam, while it remedied, in a considerable degree, the difficulty just referred to. The temperature of the whole bath was in no case reduced very materially, a constant source of heat being applied

below; but the metal which was near the bowl had its heat carried off faster than it could be supplied, and thus the temperature of the bath could show nothing more than the temperature of the bowl at the instant of projecting the water into it. The following remarks apply to the thickest iron bowl, or No. VIII., .25 of an inch thick.

One half a fluid ounce of water reduced the temperature of the bowl from  $417^{\circ}$  to a little below  $212^{\circ}$ , or through  $205^{\circ}$  Fah.

Three-quarters of an ounce, introduced at  $504^{\circ}$ , cooled the metal of the bowl below the point of repulsion for drops, or through about 120 degrees, the higher temperature of the metal more than compensating for the increased quantity of water evaporated. This bowl contained, up to the level of the bath, nearly three and a half fluid ounces. The surface was oxidated.

The following remarks apply to the temperatures of the metal when the water was first introduced.

The temperature of maximum vaporization for  $\frac{1}{4}$ th of a fluid ounce, was above  $480^{\circ}$  Fah., but probably not very far. Between  $569^{\circ}$  and  $628^{\circ}$ , the time of vaporization of the same quantity of water increased from 10 to 20 seconds, or was doubled. The time at the point of maximum vaporization was about 8 seconds. With one-half of an ounce of water the probable temperature of maximum vaporization was about  $504^{\circ}$ , and the time of vaporization  $11\frac{1}{4}$  seconds.

The different experiments with one fluid ounce of water, by comparison with a series in another bowl, indicated the temperature of maximum vaporization to be as high as  $555^{\circ}$ . At  $518^{\circ}$  and at  $616^{\circ}$  the times of vaporization were nearly the same; namely, 16 seconds.

The temperature of maximum vaporization, for two ounces, was above  $600^{\circ}$ ; at  $580^{\circ}$  and at  $602^{\circ}$ , the times of vaporization were the same; namely, 24 seconds.

This quantity was as great as the experiment could be made with, satisfactorily.

From the results we see that the times of vaporization of quantities of water in the ratio of  $\frac{1}{8}$ ,  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1 and 2, or of 1, 2, 4, 8 and 16, at the temperatures corresponding to the least time of vaporization, were about as 6, 8, 11, 13, and 22, or as  $1, 1\frac{1}{3}, 1\frac{5}{6}, 2\frac{1}{6}, 3\frac{2}{3}$ , not far from the ratio of the square roots of the quantities, which would have given 1, 1.4, 2, 2.8, 4.

The temperatures of the metal on which water being thrown will reduce it to such a degree, that the entire vaporization shall take place in the least time, increased for quantities varying from  $\frac{1}{8}$ th of an ounce up to 2 ounces, or sixteen times, from about  $460^{\circ}$  up to  $600^{\circ}$ . The ratio of the temperatures above  $212^{\circ}$  was as 1 to about  $1\frac{3}{5}$ , indicating the approach to a temperature of the metal at which any large quantity of water introduced into a thick iron vessel, would be vaporized most rapidly.

This point was elucidated directly by heating a cast iron bowl, half an inch thick, in a charcoal fire; this bowl was of the same figure, nearly, with those already described, it could contain about ten fluid ounces of water. When heated to redness, being still kept on the fire, one fluid ounce of water was introduced, and lasted about 115 seconds: 4 ounces lasted in one experiment, 294 seconds; and in another, 304 seconds; and the red heat was not kept up in the dish: the water was repelled at first.

18. In the copper bowl, No. VII., the thickness being .07 inch, or about .36 of that of the iron, the following results were obtained, the same tin bath being used, and the surface of the copper being smooth.

At a temperature of  $465\frac{1}{2}^{\circ}$ ,  $\frac{1}{8}$ th of a fluid ounce of water was repelled, the

repulsion being perfect nearly to the close of the experiment. This quantity required 175 seconds to evaporate. At the initial temperature of  $501^{\circ}$  the same quantity required 187 seconds to vaporize it. At the higher of these temperatures, in an iron bowl of nearly the same thickness, but in an oil bath, the maximum of vaporization was not reached.

One-fourth of an ounce required 13 seconds to vaporize it at  $469^{\circ}$  Fah., and 405 seconds at  $529^{\circ}$ , at which latter temperature the repulsion was perfect nearly throughout the experiment.

Three-eighths of an ounce vaporized in 12 seconds, at the initial temperature of  $471^{\circ}$ , and the metal in contact with the dish, was solid. At the initial temperature of  $486^{\circ}$  the same quantity required 30 seconds, and the repulsion was perfect for 15 seconds.

Five-eighths of an ounce vaporized in 15 seconds, at the initial temperature of  $481^{\circ}$ , and also at  $509\frac{1}{2}^{\circ}$ . The minimum time of vaporization being, probably, between these temperatures.

One ounce vaporized in 22 seconds, at  $465\frac{1}{2}^{\circ}$ , as the initial temperature; in 16 seconds, at  $486^{\circ}$ , and the tin was found congealed beneath the cup; in 17 seconds, at  $511\frac{1}{2}^{\circ}$ ; the minimum time being probably between  $486$  and  $511\frac{1}{2}$ .

Two ounces vaporized in 24 seconds, at  $511\frac{1}{2}^{\circ}$ , as the initial temperature; in 21 seconds at  $526^{\circ}$ , and in 22 seconds at  $556\frac{1}{2}^{\circ}$ ; the minimum time of vaporization being probably at or near  $526^{\circ}$  Fah.

From these results we see that between  $471^{\circ}$  and  $486^{\circ}$  Fah.  $\frac{1}{4}$ ,  $\frac{3}{8}$ ,  $\frac{5}{8}$ , and 1 oz. vaporized in times differing but little from each other, the range being from 12 to 16 seconds; and that with two ounces, from  $511\frac{1}{2}^{\circ}$  to  $556\frac{1}{2}^{\circ}$ , the time of vaporization was about four times the least of those just referred to. With quantities of water, varying from one-eighth of what the part of the bowl which was in contact with the bath, could contain, to one-half the capacity, the maximum vaporization was between  $471^{\circ}$  and  $481^{\circ}$ , and  $481^{\circ}$  and  $511^{\circ}$ , and the entire capacity of that part being filled, raised this temperature only to  $526^{\circ}$ .

This indicates the energy of the repulsion; for the evaporating surface being increased but about three times, and the water increased eight times, the initial temperature corresponding to the maximum of vaporization was raised but  $56^{\circ}$ . It shows, further, that with metal at this temperature, eight times the volume of steam was formed in three times the time, when the entire capacity was filled and compared with one-sixteenth of this capacity filled; the quantity of 6121 cubic inches of steam, or nearly  $3\frac{1}{2}$  cubic feet having been generated in 42 seconds, at the initial temperature of  $526^{\circ}$ , the steam having atmospheric pressure.

The copper, which was bright when the experiments were commenced, became oxidated as they progressed, thus tending to raise the temperature of maximum vaporization.

### *Conclusions.*

19. From the foregoing details may be deduced the following general conclusions, which will be found of practical importance.

1st. The vaporizing power of copper, when supplied with heat, by a bad conductor or circulator, such as oil, increases with great regularity as the temperature increases, up to a certain point, the water being supposed thrown upon the copper surface, in small quantities. Copper flues, heated by air passing through them, would be in this condition if left bare of water, and then suddenly wet. This holds with copper  $\frac{1}{16}$ th of an inch thick, without indica-

tion that a limit will be attained by a much more considerable thickness. The temperature at which the metal will have the greatest vaporizing power, is about 570° Fah., or about 230° below redness, according to Daniell.

The law of vaporization of small quantities of water, by a given thickness of copper, is represented with singular closeness by an ellipse, of which the temperatures represent the abscissæ, and the times of vaporization the difference between a constant quantity and the ordinates.

2d. The same power in thin iron,  $.04 \left(\frac{7}{32}\right)$  inch thick, increased regularly, and was at a maximum, probably, at 510°. With thicker metal the power increases more rapidly at the lower temperatures, and varies very little, comparatively, above 380°, with thicknesses exceeding  $\frac{1}{8}$ th, and less than  $\frac{1}{4}$ th of an inch; attaining a maximum at about 507° Fah., when the quantities are small; rising to 550°, and much above, as the quantity of water is increased relatively to the surface of the metal which is exposed. Quadrupling the quantity of water, the entire amount being still small, nearly tripled the time of vaporization at the maximum.

3d. When copper of  $\frac{1}{16}$ th of an inch in thickness, was supplied with heat by melted tin, a worse conductor, and having a lower specific heat than copper itself, the time of vaporization, in a spherical bowl, of quantities varying from  $\frac{1}{16}$ th to  $\frac{1}{2}$  of the entire capacity of the bowl, increased but three-fold, and the temperature of greatest evaporation was raised but 56°, or from 470° to 526°. When the bowl had half of the portion which was exposed to heat filled, the weight of the water was about one and one-tenth of that of the metal.

4th. The times of vaporization of different quantities of water, varying from  $\frac{1}{8}$ th of an ounce to 2 ounces, in an iron bowl  $\frac{1}{4}$ th of an inch thick, and supplied with heat by the tin bath, were sensibly, as the square roots of the quantities, at the temperatures of maximum vaporization for each quantity.

These temperatures were raised from about 460° to 600°, by increasing the weight of water about sixteen times, indicating that considerable quantities of water, thrown upon heated metal, will be most rapidly vaporized when the metal is at least 200° below a red heat.

5th. While a red heat, visible in daylight, given to a metal, even when very thick, and supplied by heat from a glowing charcoal fire, does not prevent water, when thrown in considerable quantities, from cooling it down so as to vaporize the water very rapidly, it is much above the temperature at which the water thrown upon the metal will be most rapidly evaporated. Thus one ounce of water was vaporized in 13 seconds, at about 550°, in a wrought iron bowl  $\frac{1}{4}$  of an inch thick, and required 115 seconds to vaporize in a cast iron bowl  $\frac{1}{2}$  an inch thick, at a red heat. Four ounces in the latter bowl vaporized in about 300 seconds, the bowl being red hot when it was introduced; and two ounces vaporized in 34 seconds at 600° Fah.

6th. The temperature of greatest vaporization, with a given thickness of metal, is lower in copper than in iron, the repulsive force being developed at a lower temperature. With equal thicknesses of iron and copper, the vaporizing power of the latter metal, at its maximum, was, with the oil bath, one-third greater than that of the former, and with the tin bath the power of copper  $.07$  of an inch thick, was equal, nearly, to that of iron,  $\frac{1}{4}$ th of an inch thick, each being taken at its maximum of vaporization, for the different quantities of fluid employed. As the maxima for the iron are higher than those for the copper, the advantage will be still greater in favour of copper when the two metals are at equal temperatures.

7th. The general effect of roughness of surface is to raise the temperature at which the maximum vaporization occurs, and to diminish the time of vapo-

rization of a given quantity of water at an assumed temperature below the maximum.

8th. Though it has been shown that water thrown upon red hot metal is adequate to produce explosive steam, even when it does not cool the metal down to the temperature of most rapid vaporization, it is not the less true that metal more than two hundred degrees below a red heat, in the dark, is in the condition to produce even a more rapid vaporization of water thrown upon it, than when red hot.

*Stationary Temperature of Alcohol on heated Metals.*

20. A curious fact was observed in regard to the temperature to which alcohol of the specific gravity .81, containing, therefore, 93 parts of absolute alcohol and 7 of water, could be raised in a heated dish. It is necessary, as an introductory remark, to recall the fact that when the temperature of a liquid is gradually raised, by applying heat to the vessel containing it, a limit is reached when the temperature of the liquid becomes stationary, the vapour given out in boiling carrying off the heat which enters the mass. When alcohol, of the strength above stated, was projected into a bowl heated above the temperature at which repulsion of the fluid takes place, the temperature of the liquid did not rise to its boiling point. In fact, the stationary temperature, instead of corresponding with that of ebullition, was lower as the temperature of the dish was higher. This experiment was made in the course of attempting to infer the probable temperature at which water might be repelled from the more readily attained temperature of the repulsion of alcohol. Not being of direct application to the subject before us, it was not carried as far as in other hands it would deserve.

<i>Temperature of Alcohol vaporizing in a Copper Dish, .07 inch thick.</i>			
Temperature of dish.	Temperature of Liquid.	Time of Vaporization in seconds.	REMARKS.
381°	169½		Quantity thrown in not measured, nearly fills the dish.
396	165½		
418½ a 409½	165	65	
430 a 425½	164	72	
438	164	75	
445 a 440	163	85	One ounce of liquid.
441	159¼		
448	158¼		
„	158¾		
„	159¼		
453	157¼		

(To be continued.)

*Decision of the Circuit Court of the United States, for the Eastern District of New York, in a Patent case involving some important principles. To which is appended some remarks by the Editor.*

UNITED STATES CIRCUIT COURT.

*Before Judge Thompson.*

Henry Stanley vs. Henry Hewitt.

This was an action founded upon a patent granted to the plaintiff, Henry Stanley, by the United States, the 17th December, 1832, upon a specification and application made to the patent office the 11th of October, 1832, for an improved rotary cooking stove. The plaintiff, by several witnesses, proved the originality of the invention in him, its importance and usefulness, and that the defendant had, from patterns taken from the plaintiff's stove, made and caused to be made and sold a large number of stoves, and was still pursuing the business.—The defendant to show that the plaintiff's patent was void; called Elisha Town and his son, and others to prove that in 1823 and 1824, he invented and procured to be cast a rotary stove, and that the plaintiff's stove revolved like it—also a Mr. Gould to prove that the plaintiff took the collars and flues in the cap of his stove from said Gould's stove, and also other witnesses to show that the plaintiff, as well as others, had used the collars and flues long before the plaintiff's improved cooking stove was invented; and also that the defendant attempted to show that the plaintiff had sold his stoves and given his invention to the public before he applied for his patent.

The plaintiff, in reply, called numerous witnesses to show that Town's stove, whatever it was, was useless, and had been abandoned as such; and that the plaintiff had no knowledge of it when he made his invention and improvement, and that his stove, in all the important improvements by him claimed, was wholly unlike Town's stove, and that collars and flues were not claimed by him as his invention, independently of his rotary plate in which they were attached, and that when they were put upon the Gould stove it was done at the plaintiff's suggestion. And that all the stoves delivered out before the application for the patent were delivered to be used on trial and with a view to test the utility of its improvements. The trial was a very laboured one, and occupied five or six days; but finally resulted in a question of law, growing out of the wording of the specification; which appeared to have been drawn up by the plaintiff without proper legal advice.

On the part of the plaintiff it was insisted that the claim, in his summary, was for a combination of certain improvements he had made in the cooking stove connected together and attached to the top or cap of his stove, put in motion; and that it was the combination which he claimed, and not the parts forming the combination separately, and that his specification would bear that construction.

On the part of the defendant, it was insisted that the plaintiff had so worded his specification that it would not bear that construction, and that it really claimed the different parts comprising the top or cap of the stove separately and independently of any combination, and that his specification was otherwise defective.

Judge Thompson, in the progress of the cause, gave his opinion that putting the stoves out on trial and for the purpose of experiment and improvement, was not such a public use of them as would be considered as a dedi-

cation to the public—that the plaintiff was justified and had a right to test the utility of his invention, and see what improvements might be made before he applied for his patent, and that this was an article which would be tested by being put into several families, where it might be differently used by different housekeepers.

In charging the jury, Judge Thompson, after stating the case and the difficulties arising from the obscurity of the language employed in the summary of the specification, remarked that in all cases, where consequences of great importance to the parties were involved, the jury must expect that the views of each, would be presented with great earnestness and zeal. Nor is it surprising (said he) that in such controversies, matters not materially connected with the merits of the issue, should be brought before the Court and Jury during the progress of the trial.

These remarks are applicable to the case now under consideration. It evidently involves matters of importance to the parties concerned, and has been accompanied by circumstances having no material bearing upon the questions in issue. *We*, however, are to examine the controversy, and determine it, by the law and the evidence, without reference to extrinsic matters, having no bearing upon its merits. And in this view of the subject, it is of no consequence whether the plaintiff, Mr. Stanley, has, or has not, accumulated a fortune, as the fruits of his invention. If, by his own talents, industry, and perseverance, he has produced a machine, useful in itself, and approved of by the public, he is entitled to the protection of the law, so far as he has rights to be preserved and guarded. And if, on the other hand, he has interposed claims which cannot be the subject of legal sanction, he must abide by the consequences of his fault, or misfortune.

I state to you, gentlemen, in the outset, that this is not a case free from difficulties. But I have the consolation of knowing that my decision of the matter *need* not be final, and that any mistakes committed *here*, may be reviewed and corrected by another tribunal, where I, too, shall have an opportunity of considering the subject with more care.

In my view of the case, much evidence has been introduced upon both sides, which is entirely irrelevant. The plaintiff's rights, whatever they are, depend upon his patent, and if he has any by his patent, and has not abandoned them to the public, he is entitled to protection. I confess to you, that my own prepossessions lean towards useful improvements, and I would construe the patent act with a liberal spirit, and expanded views. It is a beneficial law, having its foundations in public policy. Its object is, to encourage the enterprise of ingenious men, that the results of their labours, being brought into view, may be first enjoyed by the inventors for a limited period, and then dedicated to the public benefit forever afterwards. Nevertheless, I do not mean to say that all patents are to be protected *at all events*, but those only are to be sustained which have the sanction of law. It is a well known fact that patents are granted at the Patent Office, not after an examination into their merits, but upon *ex parte* statements, and hence their real claims may be afterwards investigated with proper strictness in a court of law.

There are some general rules always to be observed while considering this subject. In the first place, to entitle a patentee to maintain an action for a supposed violation of his rights, his invention must be both useful and new; not that its usefulness is to be scanned with a critical eye, to ascertain a given amount of benefit to be derived from it, but the invention must be useful, as contradistinguished from that which is frivolous, or wholly

worthless. If not frivolous, or entirely useless, the requirements of the law in this particular are complied with.

With regard to the invention before us, it is clearly useful; this is proved by the testimony of witnesses on all sides. It is proved, also, by the great extent of the plaintiff's sales, by the favour of the public, which has been liberally bestowed upon it, and by the palpable imitations of the plaintiff's models in the case under consideration.

If the plaintiff has legal rights here, there can be no doubt that they have been violated by the defendant. There is no substantial difference between the stove made by the defendant, and that invented by the plaintiff; the one is a copy of the other. And as to the extent of the violations, there is as little doubt. If you believe the testimony of Mr. Randal, the defendant sold a hundred stoves before the commencement of this suit, if his own declarations are to be credited, for he told the witness, in express terms, not only that a hundred stoves like these *had been sold* in Vermont, but that they had been sold *by him*. If this witness, therefore, is worthy of credit, (and he stands entirely unimpeached in every respect,) there can be no doubt that the plaintiff's rights have been violated by the defendant, if, in fact, it shall appear that he has any which the law can protect.

But the great question is, whether he has any such rights, and the solution of that question is to be found in the patent itself.

And here I may remark, that much has been proved and said in relation to the inventions of Town and Gould. The evidence upon these points is only important in one point of view, and in that it will be here considered. It shows that the materials, or component parts, of Stanley's stove are not in themselves *new*; and if the plaintiff claims a combination of things, he has evidently taken old materials to form his machine with, whatever it may be.

In relation to this part of the case, I would observe, that the particular words used in the specification and summary of this patent are of no importance. The office of words is to convey ideas, and our province is to determine what the party intended to express by the language employed. Did the patentee intend to claim the discovery of a *principle*, in the abstract or philosophical sense of that term? or did he intend to describe a contrivance, or machine, new and useful in reference to the purpose for which it was produced? He claims in his summary, "*the revolving top plate*," as a constituent part of his invention, and the first inquiry is, whether, before the use of Stanley's stove, a contrivance had been used by which the utensils to be heated had been brought over the fire, by means of a top revolving upon its centre. If the patentee claims this revolving *motion* as his own discovery, in its application to a cooking stove, he evidently includes in his patent that which is not his own discovery; for Town's stove had a revolving top, or drum, intended to accomplish the same object, by means somewhat similar.

It is very possible that Town could not maintain a patent for that invention, because he long ago gave it up, and abandoned it to the public. He did not, however, abandon it to the *plaintiff*, and all other persons might use it as well as he. If Town's discovery was abandoned, the only claim to it which Stanley can maintain, is the use of the thing as a part of his combination; and here we must determine what Town's invention was.

It is evident that he invented a revolving drum or top of a stove, to convey vessels to and from the fire by a rotary motion and concentrate the heat around them when placed there. This contrivance he gave up, or

abandoned, because it was useless, that is, useless in its then combination, though not in the abstract—for the principle or contrivance, as to the revolution, remains. As a cooking machine, the stove of Town was good for nothing; but its revolving motion might be made useful when brought in connexion with other constituents properly adapted to the objects in view.

The same remarks are applicable to the raised cones, or collars, and the flues. Each of these was old, and each had before been used either by itself or in other combinations. Stanley himself had used the collars in his own stove, as far back as the year 1828. So had Wilson—and this part of the machine is confessedly old. So with regard to the flues. If Stanley was the inventor of these, he had abandoned them to the public long before the date of his patent, and he cannot, therefore, now claim them as the subject of a patent. But the question is, whether Stanley *does* claim these materials or constituents as his invention?—for if he does his patent is void. He would then claim as his own the discoveries of others, or endeavour to maintain that which he had, by use, dedicated to the public.

If, on the other hand, the patentee claims a *combination* here, and nothing more, then I have no hesitation in saying that his rights are secured. If he goes for the elements or constituents of his machine, his patent is void, but if he merely claims a new combination of old materials, his rights may be protected. The patent itself is somewhat obscurely drawn, but the invention is useful and meritorious, and I am disposed to give it all the protection which the law will allow. A liberal construction should be given to these instruments, nor should a severe criticism be bestowed upon language used, for the most part, by the inventors themselves, who are, in many cases, altogether unskilled in the use of technical terms. We are always to ask ourselves on these occasions, what was the intention of the writers, and if that be discovered, the particular words used are altogether unimportant.

With these views, and under these considerations, I proceed now to give you my notions as to what this patent contains. It concludes with a summary in the following words:—"the *principle* for which I claim the invention, and for which I ask letters patent," is "the revolving top plate or fixture into or on which are placed the principal utensils used in cooking," &c.

By the patent law, the party is required to describe that which he makes, that the public may understand *the thing*, and be able to construct the like after the patent shall have expired; and hence there is a necessity for a proper observance of this requirement of the act. In this case, the plaintiff claims the specific thing set forth in the summary, and we must turn to the specification in order to understand what that thing is. The term used in the summary is "principle," but a reasonable interpretation must be given to it, or no sensible exposition of the parties' meaning can be obtained. He evidently did not intend to claim the discovery of an abstract thing, or entity, but some tangible mechanical contrivance, described in the specification. By "*principle*," he evidently intended a contrivance or thing described; and as there is no magic in words, we may fairly give this interpretation to the term used.

The plaintiff then patents *this* "revolving top plate," with its collars and flues, but instead of describing his invention as it really is, a *combination*, he describes the constituent parts. His improvement consists of a combination, and he should so have described it, and I have no doubt that a specification may be drawn which will secure all his rights. If the plaintiff had properly described his invention as it actually exists, his patent would have been good, for then the combination would have appeared.

But, in order to help out this part of the case, the drawings have been referred to. They show the combined thing, it is true, but the specification is silent as to the drawings, which are not necessarily to be taken as a part of it. If the specification itself made reference to the drawing, then they would become a part of it, and might be referred to for the purpose of elucidating any thing obscure in the description. But here the description is perfect without a drawing, and most probably a mechanic could make the contrivance, without resorting to the drawings at all, for explanation. The specification very clearly describes the revolving top plate, part by part, and in the summary, the plaintiff claims the entire thing described,—not as a combination, but as consisting of constituent parts, which he himself had discovered. Here lies his error, and upon this ground his action must fail. That my views on this subject may be clearly understood, I adopt the language of Lord Eldon, in the case of *Hill vs. Thompson*, [3 Merival's Rep., p. 621,] as containing what I consider a concise summary of the law on this point. He observes that “the judge, in his direction to the jury, has stated it as the law on the subject of patents, *first*, that the invention must be novel; *secondly*, that it must be useful; and *thirdly*, that the specification must be intelligible. I will go further, and say, that not only must the invention be novel and useful, and the specification intelligible, but also that the specification must not attempt to cover more than that which, being both matter of *actual* discovery, and of *useful* discovery, is the only proper subject for the protection of a patent. And I am compelled to add, that if a patentee seeks by his specification any more than he is strictly entitled to, his patent is thereby rendered ineffectual, even to the extent to which he would be otherwise fairly entitled. On the other hand, there may be a valid patent for a new combination of materials previously in use for the same purpose, or for a new method of applying such materials. But, in order to its being effectual, the specification must clearly express that it is in respect of such new combination, or application, and of that only, and not lay claim to the merit of original invention, in the use of the materials. If there be a patent both for a machine, and for an improvement in the use of it, and it cannot be supported for the machine, although it might for the improvement merely, it is good for nothing altogether, on account of its attempting to cover too much.”

After a full view of this case, I am compelled most reluctantly to come to the conclusion that the plaintiff has undertaken to secure more than he has a right to claim, and in my view of the law he cannot recover. He should have patented his combination, and not his constituent parts. I regret this result the more because I consider that the plaintiff has invented a machine or contrivance, ingenious in itself, and highly useful for the purposes to which it is to be applied. I would protect him if I could conscientiously do so, under the views of the law which I have taken, and I consider the whole matter rather as a question of law for the court, than as a question of fact for the jury. If, however, the parties prefer to go to the jury upon any of the matters in issue, they have a right to take that course—but I would choose, if I could, to put the cause in that shape which would be most likely to secure the plaintiff's rights, if I have mistaken the law applicable to the case, or given an incorrect construction of the patent.

[The plaintiff voluntarily submitted to a nonsuit, with leave to move to set it aside hereafter.]

*Note.*—The above opinion expressed to the jury in said cause, was taken down at the time by one of the Counsel for the plaintiff—was then shown

to Judge Thompson, by him examined and approved, and is published as corrected by him.

S. P. STAPLES.

S. P. Staples, J. P. Hall, and J. R. Staples were for the plaintiff.

R. M. Sherman, of Connecticut, Hugh Maxwell, Mr. Ormsby, of Rutland, Vt. and Mr. Harris of Albany, were for the defendant.

*Remarks by the Editor.*—It is truly gratifying to those who take a deep interest in the progress of the useful arts, to witness the change which has taken place within a few years in the tone of the decisions of the courts both of this country, and of England, where the rights of patentees have been concerned. Several of the judges in both countries appeared, formerly, to partake of the popular prejudice against patentees, as monopolists, whose claims ought, if possible, to be resisted; and many patents have been vacated upon grounds which we believe would now be generally deemed frivolous. It is not improbable that the name of “the Statute of Monopolies” by which the law of the 21st of James 1st, was designated, might itself have contributed towards the producing of such a result. At all events we consider the fact as notorious, and the difference at the present day as perfectly manifest. The foregoing report may serve to illustrate the position, which, were it necessary, might be sustained by numerous examples.

The patent laws of England, and of this country, are based upon the same principles, and the decisions of the English courts are, in consequence, cited in ours; there are, however, some provisions in our statutes, not contained in the British, and these of course, must govern our courts in those points to which they relate, and it has appeared to us that in one particular of this description, the foregoing decision may be considered as in some degree defective.

In the English statutes there is no provision whatever making it necessary to accompany the specification of a patent for machinery with drawings. “It was also formerly considered that the words of a specification ought of themselves to be sufficiently descriptive of the improvements, that the specification ought to contain within itself all the necessary information, without the necessity of having recourse to a diagram; and that if a diagram were given, it ought to be merely taken as an illustration, and not constituting a principal, or essential part of the specification; and therefore that a person was not bound to look at the diagram to learn the invention. But a very learned judge has however held that if a drawing, or figure, enable a workman of ordinary skill to construct the improvement, it is as good as any written description.” Godson on patents, p. 119, edit. 1823. In the act of Congress of Feb. 21st, 1793, sec. 4, it is provided that the patentee shall not only describe his invention “in such full clear and exact terms as to distinguish the same from all other things before known,” but also that “he shall accompany *the whole* with drawings and written references where the nature of the case *admits* of drawings.” Under this provision we cannot resist the conviction that in every thing which *admits of drawings*, these drawings and written references, imperatively required by the statute, do make a component and necessary part of the specification, and that they are not to be taken as merely an illustration. In the drawing up of specifications of things which “*admit of drawings*” it would always be advantageous to refer to them in the body of the specification, and the only reason for omitting this is to save expense, as, in such cases, two copies of the drawings are required, one to attach to the patent, and the other to remain in the office. The practice of the office, and not the requirements of the law, has made a copy of the specification a component part of the patent; this practice arose from the impossibility of

carrying that part of the law into effect, under a literal construction of it, which requires that the patent shall contain "a short description of the said invention, or discovery." A specification which is without written references to drawings, might be considered as fulfilling this intention; but not so where it contains within itself references to the drawings, as it could not, in that case, be understood, without attaching these also to the patent.

There are some points relating to this subject which we have left untouched, although we think them of much importance, but more space would be required for their investigation than it is thought proper to occupy at present, and they are therefore omitted.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On making Sugar from Plants which thrive in the Temperate Zone, and north of the Climate where the Sugar Cane can be cultivated with success.*

The article Sugar, strictly considered, ranks amongst the luxuries of life; but its pleasant taste, good qualities, and our habit of using it, has made the luxury a necessary article to a very large portion of the citizens of the United States.

Through various channels, the public are informed, that in consequence of measures adopted into the colonial policy of foreign nations, the process by which sugar has heretofore been produced, will be much deranged, and the supply greatly diminished.

The only concern that the Franklin Institute has with measures of this kind is, to bring scientific power to bear upon them, so as to reduce to its lowest point, their tendency to do ill, and to carry their capacity of doing good to its maximum. If the change of colonial policy, that is spoken of, should lead to a diminished supply, this will be followed by an increased price; and much privation of comfort must be experienced, until people acquire the habit of doing without sugar, should no new mode be discovered by which the article can be produced.

In this stage of the business, there is a propriety in the Franklin Institute turning its attention to making the citizens of the United States acquainted with what has been done in producing Sugar from plants growing in forty-eight degrees of north latitude. It is impossible, at this time, to appreciate the value of the services conferred on society, by the labours and discoveries of the French chemists, who have shown to the world, that a supply of sugar is to be had from plants growing so far north. These discoveries will prove one of the great scientific victories that characterise the chemistry of this age.

Translations of all that has been published in France, on this subject, if presented to the patrons of the Journal of the Franklin Institute, would be of great value, not only to them, but to the whole nation; the information contained in the French treatises, will be rendered still more valuable, if they are followed by essays from men of science, in our own country, who are acquainted with its soil, climate, agricultural and manufacturing resources. Although the natural circumstances of the United States, evidently are favourable to this branch of agriculture, the subject has had little, if any attention bestowed upon it, we are almost ignorant of all that has been done or written about it.

The beet, and some other sacchariferous roots, when cultivated in France, mature their saccharine juices so perfectly, that they admit of crystallization. There is every reason to presume that the same plants, with equally good cultivation, would advance to higher perfection throughout the

United States; and this greater perfection must be the result of our warmer summer.

The weight of beets and roots that might be grown to make Sugar from, is so great, that the sugar farmer, in most instances, would necessarily become the sugar maker; be his own chemist, and have his own laboratory: for in fact, the planter's sugar house is a laboratory,—only that the Pennsylvania and Ohio sugar house will differ from the Jamaica one, by having for a companion, the English cow-shed; for it must be recollected that the refuse or pulp of beets will feed cattle, whereas the squeezed cane is worthless trash.

The readers of the Journal will see that the present paper has solely in view to awaken their attention to a subject of great importance, in its relations to agriculture, manufactures, commerce, and the comforts of society. This is only doing what the Institute, on former occasions, has effected, through the publications in the Journal, by exhibitions, and by premiums. By these means, it has brought forth the energies of men of talents, and the result has been the supplying ourselves with many things, the want of which would now be felt, as a very great calamity. J. R.

January 12, 1836.

*Remarks and Inquiries respecting Mr. Avery's Patent Steam Engine.*

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

SIR—You have doubtless seen in a late number of the New York Mechanic's Magazine, (the one for September I think) an engraved drawing of "Avery's Rotary Steam Engine," accompanied by a description. It is generally believed that this engine has been secured to Mr. Avery by patent. I have always supposed the main object of the patent law to be, the *protection of original inventors* in the enjoyment of whatever pecuniary advantages they may fairly derive from their useful inventions.

That Mr. Avery's engine, or one constructed upon the same principle of action, though perhaps somewhat different in detail, will be found in some situations a convenient and economical machine, I do not doubt. Indeed, I know some persons who would like to make use of such engines, but who are, some of them unable, and all unwilling, to pay Mr. Avery for the privilege of doing that which they feel themselves equally at liberty to do with himself. My reasons for doubting the validity of his patent, may be found, *first*, by referring to the September number of the New York Mechanics' Magazine for 1833, in which is given a drawing and description of the beautiful contrivance of Hiero, the first account of which is said to have been published in the year 1571.

The principle upon which Mr. Avery's engine acts, will, I think, be seen at a glance, to be the same as that of Hiero's. *Secondly*, in a work by Oliver Evans, entitled the "Young Steam Engineer's Guide," published by Carey & Lea, page 93, the biographer of Mr. Watt, speaking of his first attempt to produce a direct circular motion by steam, says, "he (that is, Mr. Watt) then tried Parent's or Doctor Barker's Mill,\* inclosing the arms in a metal drum which was immersed in cold water; the steam rushed rapidly along the pipe which was the axis, and it was hoped that a great

\* Descriptions of Barker's Mill may be found by your readers, in Ferguson's Lectures, Nicholson's Operative Mechanic, and almost every reputable work on Mechanics now in use.

reaction would have been exerted at the ends of the arms, but it was almost nothing, the reason seems to be that the greatest part of the steam was condensed in the cold arms. It was then tried in a drum kept boiling hot, but the impulse was now very small in comparison with the expense of steam." Upon this experiment Mr. Evans remarks as follows: "It is evident from this account that Mr. Watt has used *weak steam*, and placed dependance on the use of a condenser; had he in his experiment with Doctor Barker's Mill, lessened the apertures by which the steam issued, so as to confine the steam until the power in the boiler was equal to 100 lbs. to the inch, he would have been astonished to see it revolve about 1000 times a minute, supposing the rotary tube to have been three feet in length; I have tried the same experiment, but without the least hope of success, on any other principle than by confining the steam to increase its elasticity to a great degree. My rotary tube was three feet long, the elastic power of the steam about 56lbs. to the inch; it revolved with a velocity of about 700 to 1000 times a minute. The aperture by which the steam issued about  $\frac{2}{10}$  of an inch diameter; it exerted more than the power of two men, and would answer to turn lathes, grindstones, &c. when fuel is cheap. I have specified and explained it in the Patent Office." Unfortunately, there is no date to this work of Mr. Evans, but I presume it can be readily ascertained in Philadelphia, when it was published, and probably when the specifications were entered at the Patent Office. But that it was done long before Mr. Avery's engine was thought of, I think there can be little room for doubt, as it appears from another part of the same work of Mr. Evans, page 96, that he *matured* his experiments upon the application of steam to a wheel, in the year 1784, which, as he states, he described in the Patent Office.

Under these circumstances, I cannot see what possible claim *Mr. Avery* can have to a patent for this invention; as to the drum which encloses the arms as represented in the drawing of his engine before referred to, I understand it is claimed as having been first applied to it, by a Mr. Clark, of some western town in this state.

By giving the foregoing an *early* insertion in your Magazine, you will sir, *essentially* oblige several of the friends and readers as well as promote the cause of justice. Should you be willing to express your own opinion as to the merits of this question, it would be deemed particularly valuable.

FAIR PLAY.

*Remarks on the foregoing Communication, by the Editor.*

It so happens that "Fair Play," and others, who desire information on the subject of Foster and Avery's Reacting Steam Engine, (commonly called Avery's) will, in the present number, have a full opportunity of seeing what constitutes the claim of these gentlemen to a patent for an improvement in this machine. They were fully informed respecting what had been attempted with engines similar in construction to their own, previously to their obtaining a patent; and it will be seen that they have confined their claim to improvement within very narrow limits, and so far as we are informed, their claim is a valid one. It may be said that their improvement is trifling; that, however, is their own concern, as those who do not need it are at full liberty to use the machine in any of the various forms which had been previously given to it, or to devise others which are new, without buying from them what may be deemed unimportant.

We are not sufficiently well informed respecting the comparative results

obtained from Avery's and the reciprocating, or Avery's and other rotary engines, to make up our minds respecting its real value ; between four and five years, however, have elapsed since this engine was patented, and it has been at work at Syracuse, and various other places, during the whole of that time, so that those who have seen it, and who possess a competent knowledge of the subject, have had time enough to investigate it. Before the patent was obtained, we expressed to Mr. Avery, our general want of confidence in the real value of such engines, and our doubts respecting the importance of the improvements claimed; and we did not suppose that the career of the one in question would extend to two years, a length of life, greater than has usually fallen to the lot of rotary engines ; it still lives, however, maugre our anticipations; and all the reports which we have received relating to it, tend to show that it has not yet exhibited the first symptoms of decline. Although we still adhere to the opinion, that upon a full comparison, the economy of a good reciprocating, will be greater than that of any rotary engine that has been, *or will hereafter be*, made, we most cheerfully confess that we have a much better opinion of Mr. Avery's, than we at first entertained ; and, as to our wishes, they are that by the operation of this, and a hundred other contrivances, which we have esteemed of like value, we may be put entirely in the wrong ; let the fact be well established, and we would be the first to make it public. Without putting in an undue claim to the *suaviter in modo*; we have sometimes thought that the tendency of our animadversions upon patented inventions was to place us in the situation of "The best good-natured man, with the worst ill-natured muse;" it must be recollected, however, that we stand between the claimants of exclusive privileges, and the public.

With respect to the amount of novelty necessary to security, as a foundation for a patent, we think that the fair test of this is the utility of the improvement; if it renders that valuable which was of little comparative worth, it is enough, although it be no more than the addition of a screw, or of a peg. The views which we have adopted upon this subject, may be found at large in Vol. 8, p. 411 of this Journal. The article is a borrowed one, and well worth perusal. "The main object of the patent law is the *protection of original inventors* in the enjoyment of whatever pecuniary advantages they may fairly derive from their useful inventions," and in attaining this end, it is not possible to test them by comparative weights, or to measure them by any established scale; absolute quantity, however small, is all that can be required.

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### Civil Engineering.

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*Report to the President and Managers of the West Philadelphia Rail Road Company, by H. R. CAMPBELL, Civil Engineer.*

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN—I am directed by the President and Managers of the West Philadelphia Rail Road Company, to request the insertion in the Journal of the Franklin Institute, of the Report of their Engineer, accompanied by a map of the road.

This report contains some facts respecting the superiority of the Locomotive Engines made in this city, over those in use on the Columbia Rail Road which were imported from England, that are highly creditable to the

state of the arts in this country, and ought to be made known as extensively as possible. The work on the West Philadelphia Rail Road is in a forward state, and will be completed within the period contemplated.

Very respectfully, your obedient servant,

THOMAS FLETCHER.

*To the President and Managers of the West Philadelphia Rail Road Company.*

GENTLEMEN—I have the honor to report, that the line of the West Philadelphia Rail Road, has been located in conformity with instructions received from the Board. The ground over which it is traced is well adapted to the construction and grade of the road. The excavations and embankments are generally light, and by no means of an expensive character. But few small streams are crossed, and consequently but few culverts and bridges will be required, which will be built of stone in the most permanent and durable manner. In the location of the route particular care has been taken to avoid curves, and no curves have been made upon a less radius than four thousand feet.

The maximum rise of the graded surface of the road, is 46 feet per mile, which is only one foot per mile more than the maximum grade of the main line of the Columbia and Philadelphia Rail Road. A small portion of the line is level, and about one and a half miles are graded at 38 feet per mile. The average grade is  $43\frac{3}{10}$  feet per mile, its length being  $7\frac{1}{2}$  miles, and total rise 325 feet.

From its juncture with the Columbia Rail Road, a short distance below the Buck Tavern, the route is nearly straight to the Market Street Permanent Bridge over the Schuylkill River, and more direct than the main line of the Columbia Rail Road. By its completion a new outlet will be opened to the travel and transportation of the Columbia Rail Road, and the inclined plane at Belmont will be avoided. The distance from the city of Philadelphia to the head of the inclined plane is about 4 miles; the nearest point to which locomotive engines can approach the city. By the West Philadelphia Rail Road, locomotives can carry their trains to the line of the city proper, at Market Street Permanent Bridge, and to the tide water of the Schuylkill opposite the city.

Trains of cars by this route, propelled by locomotive engines, will gain one hour in advance of those which pass over the inclined plane, by the main route of the Columbia Rail Road. This circumstance is alone a sufficient inducement to divert the travel and a large portion of the transportation from that Rail Road. Statements have been made in the public papers, since the commencement of the West Philadelphia Rail Road, that the construction of a line was contemplated by the Canal Commissioners of the State, by which the inclined plane is to be avoided, without exceeding a grade of 25 feet per mile, and an increased distance of two miles. It is due to the stockholders of the West Philadelphia Rail Road and to the public, to state, that no such route exists, and that the name of the engineer, given as authority upon which the statement was made, was used without his permission or consent.

The importance of avoiding inclined planes upon roads constructed for the accommodation of passengers traveling, is beginning to be justly appreciated. By reference to the recent report of the Baltimore and Ohio Rail Road Company, it will be found, that measures have been taken by

them, to abandon those parts of their road upon which inclined planes have been constructed, and to construct new lines upon which locomotive engines can ascend without the aid of stationary power. By experiments made on the Columbia Rail Road with locomotive engines, the question has been settled, that 45 feet per mile, is an inclination upon which that species of power can be applied with more advantage than any other. The fact, that the original design was abandoned, of adopting stationary engine power on the Rainhill and Sutton inclined planes of 55 feet per mile, on the Liverpool and Manchester Rail Road, in England, to the more advantageous use of locomotive engines, might also be adduced as evidence, that even steeper grades, may be safely adopted.

The locomotive engines on the Columbia Rail Road, which were manufactured by Mr. Baldwin, of Philadelphia, carry trains of 20 and 24 cars, containing each three tons of merchandise, up 45 feet grades at 10 to 12 miles per hour; while engines of English construction, from the works of Robert Stephenson, Esq. the celebrated engineer, carry upon the same road only 14 cars, at the same rate of speed. This great difference is produced by the superior arrangement and mechanical application of power to Mr. Baldwin's engine, and not from any difference in the weight and *adhesive* power of the respective machines.

It has been clearly ascertained that Mr. Baldwin's engines, under all circumstances, are able to generate more steam than is adequate to overcome the adhesion of the wheels upon the surface of the rails, while those of English construction are unable to keep up a sufficient supply. These facts are mentioned as evidence of the progressive improvements in the science and construction of locomotive engines, and of the perfection to which their manufacture has arrived in our own country. The durability of these engines, and the amount of annual repairs, are not less striking than the result of their effective force.

Enough, it is presumed, has been said to prove conclusively, the superiority of the route of the West Philadelphia Rail Road, over that portion of the Columbia Rail Road which it is destined to rival. With regard to the comparative distance of the two lines, the former is about half a mile shorter than the latter, from the intersection of Broad and Market Streets. The whole cost of the West Philadelphia Rail Road, including a double track of edge rails, laid on foundations of locust timber, will be \$250,000. The work is all under contract and rapidly progressing to completion.

The grading will be finished by the 1st of May, 1836, and the rails will be laid ready for travel by the 1st of August following. Contracts have been made for iron edge rails, of a pattern similar to those of the Camden and Amboy Rail Road, to weigh 60 lbs. per lineal yard, and also for all the materials necessary to complete the work, which are to be delivered in all the month of April next. The Board have every reason to be satisfied with the progress of the work under the respective contracts. The prices are generally fair, and no obstacles exist to the completion of the road within the time specified in the contracts.

H. R. CAMPBELL,

Engineer of the West Philadelphia Rail Road.

Philadelphia, October 15, 1835.

## Physical Science.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Experiments on Endosmosis.* By JOHN W. DRAPER, M. D. *Christiansville, Mecklenberg, Va.*

1. The interstices which exist in a great variety of bodies, may be looked upon as a large system of capillary tubes, into which we should be prepared to expect, that bodies of all kinds might pass. A drop of water, placed upon a porous stone or chalk, sinks into it rapidly, but the value of the observation is lost, because it is common. If that water contained a colouring matter, we should find that in sinking into the chalk, the colour would be left on the surface. But here again common place principles dictate a ready answer, the interstices of the chalk may be supposed to be too small, to admit the colouring matter to pass, or perhaps some incongruity of shape might afford a barrier; yet, how upon these principles shall we explain, that mercury and other bodies remain unmoved upon the porous mass, and show no ability to go through it, when they will pass with readiness into the densest and closest substances, as gold. No principle of coaptation will explain why quicksilver will not rise in a tube of glass, or why water rises at all. We are thrown at once to refer the whole matter, to the the chemical conditions of the bodies on which we operate, and we quickly infer, that fluids do not pass into pores by soaking or leakage, or any such common-place principle, but that it is an action determined by certain laws that have reference to the condition of each body, separately, and their relation to each other. A question therefore naturally arises, as to the peculiar operation of those pores, and how changes in their position, size and shape, would affect the results of their action. A class of these phenomena is quite independent of pores of any sensible size, when no leakage or oozing can be suspected. A piece of sugar dissolving in water, diffuses itself into every part of the menstruum. Among those excessively small interstices, that exist between the least atoms of the water, its particles find a dwelling, where they are sheltered from all those forces that act so energetically on the great masses of matter. Independent of gravity, they move freely in every direction, and far from settling in those positions to which they might tend from their weight, they are simultaneously and equally found, in every portion of the solvent. This condition of things does not indicate a passive state, but would rather teach, that a very active and powerful force is in operation, a force that can neutralize the action of gravity, and other external agents. It is essential, therefore, clearly to understand the circumstances of this absorption; it may take place independently of apertures, pores or vessels, it may take place between gases and gases, gases and vapors, or liquids, or solids, or mutually and indiscriminately among them all.

2. When a liquid rises in a capillary tube, only those portions are under the direct influence of the attractive force of the tube, which are nearest to it; the central columns being entirely unaffected. Also, when water jets out through a narrow pipe, it is only those portions that are directly in contact with the sides of the pipe, that are subject to its resisting influences, any disturbance which, the central particles feel, arising only indirectly from their cohesion. The same applies in the passage of liquids among pores, the diameter of these pores amounting to a certain size, they will admit a pas-

sage, without exerting any direct influence. Thus, a pore in a piece of charcoal, may suffer a column of water to go through it, without in anywise affecting the central portion of that column, by reason of its size, but should the diameter of the pore be made to decrease, it is obvious a limit might finally be reached, where every particle that passed, should come under the direct influence of the physical force exerted by the pore, and none pass by mere leakage, or oozing.

3. This leads us to consider the different effects that may ensue when the same liquid or gas passes through pores of various sizes, in the same solid. An example may perhaps illustrate the results. The walls of a pore are so constituted, as to allow an easy passage of one gas, as oxygen, along them, and afford more or less resistance to another, as nitrogen gas. Now, if we suppose this pore to be of very large size, and atmospheric air to be passing through it, little or no change will happen, in the constitution of the passing gas, all the internal parts of the current being out of the reach of the walls of the pore; but should the diameter of the pore be reduced to the diameter of an atom of the compound gas, or thereabouts, the oxygen finding little or no resistance, would glide through, and the nitrogen be retained. A perfect decomposition happening. This shows the importance in all investigations relative to the Endosmosis, or transit of bodies through pores, to bear in mind, that when those pores have a certain diameter, the results of experiments made on them are illusive; not representing alone the nature and value of the force exerted by the walls of the pore, but showing effects depending also, on the cohesion and other properties of the passing body.

4. These observations apply to those experiments which have been made to illustrate the phenomena of endosmosis by forcing gases through plugs of stucco, which are systems of capillary tubes of large size. Experiments on charcoal, plaster, &c., are also open to the same strictures. Had these only been resorted to, not the simplest phenomena of endosmosis could have been revealed. The disturbance of hydrostatic level, which is so well shown by a sheet of gum elastic, or an animal membrane, cannot be produced by the use of plugs, with large pores or systems of capillary tubes.

5. It might at first be expected, that as the diameter of a pore decreased, its indisposition to admit a foreign body, would increase, but it is not so—that foreign atom does not insinuate itself in a passive manner; nor does it go through the pore, merely because it meets with no resistance. There is an active and very energetic force in play, a force that is even greater, than the cohesion of the parts of the pore itself. Hence, under like circumstances, the smallness of such a pore is no bar to its receiving and transmitting foreign atoms, but very often in an experimental point of view is the most favourable condition, under which we can study its action without any retarding or complex causes.

6. There are some experimental illustrations of the fact, that closeness of texture is no hindrance to the passage of suitable bodies. I took a narrow glass pipe, about an eighth of an inch in diameter, and dipping an end of it into melted gum lac, expanded thereon a bubble of that substance, by blowing at the other extremity. In this way, after a few trials, it may be made so thin as to be translucent. Such a bubble, with air from the lungs in its interior, being exposed to an atmosphere of ammoniacal gas, allows a free passage to it. A singular change in the appearance of the thin membranous bag takes place during the experiment, from being brown in the thicker parts and whitish in those that are more translucent, it becomes of one uniform flesh colour. Now, in this state, it may be regarded as one of the most

impervious of all resinous bodies, and certainly of them all it has the closest texture, yet after it has thus been exposed for a short time to ammonia, we find on passing into its interior a little reddened litmus water, that the gas is present in large quantity, and must of course have been transmitted, along the pores in the resin.

7. On the top of a tube which contained atmospheric air, and a piece of litmus paper, tinged red by the fumes of muriatic acid, I fastened very carefully a piece of gold leaf, two tenths of an inch in diameter, with gum water, and suffered it to dry. The gold leaf, when examined with a lens by transmitted light, appeared all over of an uniform pea green colour, nor could any hole or flaw be perceived in it. It was covered with a jar of ammonia, on the mercurial trough; the level of the mercury, on the inside and outside, being regulated. The gas went through the gold leaf rapidly, and in a very short time the test paper became uniformly blue. On using carbonic acid, or sulphuretted hydrogen, the action was very nearly as instantaneous.

8. I split, with a lancet, a thin plate of Siberian mica, which for the most part appeared of a flame colour, but in places where it was unequally thick, a blue or a red. This lamina, when substituted for gold leaf in the last experiment, suffered ammonia to pass through it. A similar plate of sulphate of lime, from Sheerness, England, suffered half a cubic inch of carbonic acid to pass through it in forty minutes. Atmospheric air in all these cases was on the other side.

9. These permeations, which we have noticed to take place so rapidly under favourable circumstances, occur likewise more slowly in nature. A sea shell, for instance, deposited in that formation called London clay, in course of time loses its coagulated albumen, then its carbonate of lime, and its other ingredients, simultaneously or successively. These are replaced by the sulphuret of iron, by alumina, oxide of iron, &c., which form together a mass of so close a texture, that it can give sparks by collision. Under such circumstances as those which occur along the coast of the island of Sheppy, a thin plate of carbonate of lime is permeated readily by bisulphuret of iron, so that there is a continued deposition and accumulation of that substance, in the interior of a thin shell. Hence the production of that immense quantity of fossil shells, which is there used for the purpose of manufacturing copperas for commerce. Slow motions of the same kind occur, when alloys are buried under the ground, or placed in exposed situations, a silver Roman coin has thus been known to part with much of its copper, which formed a species of crystalization on its surface, the *patina* of antiquarians. It is in this way, that trinkets of gold, on which small quantities of mercury have fallen, gradually recover their original brilliance and purity. A number of facts of this kind, showing that even in the most solid of metallic textures, motions may take place, might be referred to: these have been well considered by Boyle, in his tract on the languid motions of bodies.

10. Caoutchouc, or gum elastic, is the substance which of all others has furnished the most unexceptionable results, on studying the phenomena of endosmosis. It however at times exerts a synthetic action, which so far as I know, has not yet been noticed. Having capped an open tube, with a thin piece of this substance, and thrown into it 200 measures of hydrogen gas, it was exposed to an atmosphere of 100 measures of oxygen, contained in a wider tube, into which it was raised. In eleven days the level in both tubes was considerably raised, and the barrier which was at first of a blackish co-

lour, became quite white. In sixteen days, the united volume of both gases was only 215 measures, this on analysis contained only 14 per cent. of oxygen. It may here be stated, that a like mixture of 100 of oxygen, and 200 of hydrogen, enclosed together in a tube by the side of the former, had undergone little or no diminution. Now a rough calculation shows, that about one thirteenth of the united volume of the gases had been condensed by the membrane into water, the remaining 62.35 parts of oxygen having combined, after some chemical manner with the substance of the caoutchouc, in the process of bleaching it.

11. This result points out the condensing effect of a membrane, which often, in many arrangements, will have no small influence. Thus in Dr. Mitchell's experiment, where two bent tubes are screwed together, with a piece of gum elastic between them, the one tube containing oxygen, and the other a double volume of hydrogen, we should be led to expect, from the common theory of endosmosis, that however much the levels in the two tubes might vary, relatively to each other, the united volume of the gases ought to remain constant. If the level in the hydrogen tube rose an inch, ought not the level in the oxygen tube to sink an inch? But an appeal to experiment shows, that such is by no means the fact; to a certain extent, the volume of gas in the tubes is constantly diminishing, it is not due to leakage into the free atmosphere, between the membrane and the glass, that presses it, at least not entirely so, a part of the gases is condensed by the direct action of the barrier, to form water, and the remainder unites chemically with it. In some instances the action is still more obvious. If a vessel of atmospheric air, the mouth of which is covered by a piece of india rubber, be immersed in an atmosphere of deutoxide of nitrogen, it will not be found that red fumes will appear in the vessel, nor any other obvious indication of the presence of the deutoxide then, but the membrane soon begins to change its colour, and from being diaphanous becomes of a dirty umber brown, the volumes of the gases on both sides of it diminishing.

12. Into a tube which was covered with India rubber, and exposed to the free atmosphere, I placed 100 measures of atmospheric air, and 42 of hydrogen gas, as it stood on the shelf of the pneumatic trough, being anxious to see if any passage of the gases would ensue, as the oxygen and hydrogen in the mixture, were in nearly a due proportion to form water. Motion at once began, the level of the water in the tube rising for several hours. In the course of a few days, only a trace of hydrogen was discoverable, the remaining gas differing very slightly from atmospheric air. The same was repeated with a tube closed by a serous membrane, kept continually moistened, when all motion appeared at an end, analysis showed that there was only  $\frac{1}{10}$  of the whole volume of hydrogen beneath the membrane.

13. These experiments which were repeated again and again, with the same results, establish an important doctrine. If a gas be confined beneath a system of pores, the other extremity of which communicates with another gas, movement will ensue, until the constitution of the gas on both sides of the system is alike. If oxygen and hydrogen be thus placed, they will mutually pass to each other, nor will that motion cease, until the resulting compound, on both sides of the membrane, is the same chemically. This endeavour to an equalization of constitution, takes place under all circumstances, it may perhaps be partially arrested by the condensing action of the barrier. (11.) There are therefore two prominent conditions under which the phenomena of endosmosis may be regarded: 1st. During the state of motion. 2nd. After an equilibrium is obtained.

14. Aided by this principle, we can explain how mixtures of gases would comport themselves, when exposed to free atmospheres, or when shut up in close chambers. The arrangements of (12) will serve as an illustration, here we have a mixture of atmospheric air and hydrogen, exposed to the free atmosphere. It is evident, that in pursuance of an attempt to gain an equilibrium, a portion of air from the atmosphere should pass inwards through the membrane, and a portion of hydrogen pass out. But as soon as the hydrogen is beyond the outside of the membrane, it is dissipated by aerial currents, or otherwise diffused in the mass of the atmosphere, the condition of equilibrium being in no wise approached to, for so fast as the hydrogen escapes, it is carried off; there being continually hydrogen and atmospheric air on one side of the membrane, and only atmospheric air on the other. Equilibrium, therefore, can only be gained by the entire dissipation of the hydrogen into the free air, and accordingly experiment indicates, that when that equilibrium is gained, the hydrogen has vanished, and atmospheric air is found on both sides of the membrane. But very different would that action be, if the arrangements were included in a close chamber, as beneath a small glass bell; here, when the hydrogen comes out through the membrane, it does not escape, but continually accumulates, and motion ceases, and equilibrium is gained when the relative proportion of the gases outside the membrane, is the same as inside. Hydrogen, therefore, in this case is found on both sides of the barrier.

15. Before proceeding to give an account of the chemical changes, that may happen in virtue of the action of capillary forces, it is necessary to remark, that all the analyses of gaseous mixtures in which oxygen is an element, have been uniformly made by means of binoxide of nitrogen. Living in a climate where no dependance can be placed on the action of an electrical machine, and not possessing Dr. Hare's galvano-ignition apparatus, I was led by necessity to choose between spongy platina, and the binoxide of nitrogen. After an experience of some extent in the employment of this gas, it has not appeared to deceive me,—it is indeed an eligible method in gaseous analysis, where oxygen is concerned. The mode of manipulation is as follows: with the sliding rod eudiometer, throw 100 measures of the gas under trial, above the surface of water, that has been duly exposed to the atmosphere, and contained in an inverted bell, rather wide in proportion to its depth; one made of the belly of a glass retort, or a cupping glass, answers very well. Then add 100 measures of the binoxide of nitrogen, if the gas is suspected to be poor in oxygen, but 200 or more, if the gas is richer, always observing to have the binoxide in excess. After the lapse of a minute the absorption is complete; measure the residue, and one fourth of the diminution gives the volume of oxygen, this method is analogous to that of Gay Lussac. Some idea of its correctness may be formed from the circumstance, that of 73 analyses of the air, the mean result of the amount of oxygen is 20.58 per cent. My measuring rod divides each volume into decimals by a vernier arrangement; but for most purposes of analysis this is unnecessary.

16. It results from the observations which have been made on caoutchouc, by Dr. Mitchell, that oxygen passes with much more facility through it, than nitrogen gas. Atmospheric air is also reputed to be a mixture, and not a chemical compound; it was therefore an object to try, whether pure oxygen might not be obtained by forcing air through such a membrane. Filtering or in fact straining it through a gum elastic bag. A thin piece of this substance, was therefore tied tightly over a tube an inch in diameter, and six

inches long, the tube was then filled with mercury, in such a manner that the great weight might not burst the caoutchouc, it was then inverted, and exposed to the atmosphere. The membrane bulged into the tube, in a deep hemispherical form, in about an hour its under surface was studded with bubbles of gas, and in the course of time, several cubic inches passed. This, on analysis, by means of binoxide of nitrogen, was found not to differ sensibly from atmospheric air. A similar result was also obtained, when a thin serous membrane, a piece of peritoneum stripped from the liver, was substituted for the gum elastic. No indications whatever could be obtained, that atmospheric air was decomposed, during the process. Nor is it difficult to understand and explain how this happens, when a foreign force, equivalent to a pressure of six inches of mercury, is brought to bear so advantageously on the action of a very thin membrane, for in the case of the gum elastic, the thickness could not be estimated at more than  $\frac{1}{360}$  of an inch, and the serous membrane was so porous, that it could not sustain so heavy a pressure, without immediate leakage; the united gas whatever it may be, is at once forced through, the barrier being unable to stop it. A case of the same kind is met with, when porous charcoal is used, pressure forces a gas through it entirely unchanged, but if the effects of that pressure be avoided, chemical decompositions may ensue of a decisive character, as we shall shortly have occasion to see. To obtain these chemical effects, it is necessary that the barrier should not only have no pores of sensible size, but that no adventitious or foreign forces, be brought to act on the passing gas; in proportion as these conditions are fulfilled, the success of the experiment is more perfect, and thus as we shall proceed to point out, it is possible to strain the nitrogen out of atmospheric air, and procure by that means oxygen of greater or less purity.

(TO BE CONTINUED.)

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*Historical Note on the Discovery of the non-conducting power of Ice.* By  
A. D. BACHE, Prof. of Nat. Philos. and Chem., Univ. Penn.

In the fourth series of his electrical researches, Mr. Faraday devotes himself to the establishment of a "new law of electric conduction." In the course of experiments for this purpose, he says that he "was suddenly stopped by finding that ice was a non-conductor of electricity, and that, as soon as a thin film of it was interposed in the circuit of a very powerful [voltaic] battery, the transmission of electricity was prevented." This observation is made to lead to a beautiful train of research on the conducting powers of various oxides, salts, chlorides, &c., capable of existing in both the solid and liquid states. In these experiments, a galvanic battery of two troughs, containing twenty pairs of four inch plates, was used.

Similar results were obtained with electricity from the machine. A thickness of five-sixteenths of an inch of ice scarcely allowed the electricity to pass at all, though of this high tension.

It seems, then, that Mr. Faraday thought it necessary to investigate this fact, which he had accidentally observed in relation to galvanic electricity, in its application to electricity as evolved from the machine.

That ice is a non-conductor of electricity, thus evolved, was, however, well known to Doctor Franklin, and his associates; and whatever merit attaches to this discovery, which was considered a curious one, belongs to him, or to them.

In one of a series of letters to Mr. Peter Collinson, of London, dated in

1747 and 1748, in which he gives an account of experiments made by himself, Kinnersley, Hopkinson, and others, Doctor Franklin has the following remark: "A dry cake of ice, or an icicle held between two in a circle, likewise prevents the shock, which we would not expect, as water conducts it so perfectly well."

Again, in a paper on the aurora borealis, read before the Royal Academy of Sciences of Paris, in April, 1779, and entitled, "Suppositions and Conjectures towards forming an Hypothesis for the Explanation of the Aurora Borealis," the basis of his theory is this same want of conducting power. He says: "Water, though naturally a good conductor, will not conduct well when frozen into ice by a common degree of cold—not at all when the cold is extreme."

"The great cake of ice that eternally covers those [the polar] regions, may be too hard frozen to permit the electricity" "to enter the earth." "It may, therefore, be accumulated upon that ice."

Dr. Watson had previously affirmed ice to be a conductor; and, subsequently, Bergman and others were of the same opinion, doubtless from their not attending to the "dryness" of the ice. Bergman found reason to change his opinion, and Achard, Erman, and others, have confirmed the accuracy of Franklin's statement. These authorities have caused ice, at a low temperature, to be ranked among electrics, in the elementary works devoted to the subject.

As far as the passage from the solid to the liquid state is concerned, our electricians seem to have been better informed than the following sentence from the paper of Prof. Faraday, before referred to, supposes.

"This assumption (he says) of conducting power by bodies as soon as they pass from the solid to the liquid state, offers a new and extraordinary character, the existence of which, as far as I know, has not before been suspected."\*

It is true that this remark applies particularly to galvanic electricity, but as Mr. Faraday repeated many of his results with the machine, to prove them to be coincident with the others, he obviously does not intend to limit his remarks. "All these effects," he says, "produced by using the common machine, and the voltaic battery, agree, therefore, with each other."† Again, "The conducting power of these bodies, when fluid, is very great."‡

In a letter to Cadwallader Colden, of New York, dated Philadelphia, April 23d, 1752, Dr. Franklin says, "I do not remember any experiment by which it appeared that highly rectified spirit will not conduct; perhaps you have made such. This I know, that wax, rosin, brimstone, and even glass, commonly reputed electrics *per se*, will, when in a fluid state, conduct pretty well. Glass will do it when only red hot."

He again states the same fact in the paper on the aurora, before referred to, thus: "A certain quantity of heat will make some bodies good conductors, that will not otherwise conduct."

"Thus, wax rendered fluid, and glass softened by heat, will both of them conduct."

"And water, though naturally a good conductor, will not conduct well when frozen into ice."

In these effects, our electricians saw only the general effect of heat on

\* Prof. Faraday's experimental researches in Electricity. Fourth series. Art. 412, Royal Soc. Trans., 1833.

† Ibid., art. 431.

‡ Ibid., art. 430.

the conducting power of bodies, while Mr. Faraday ranks the effects observed by him in quite a different class, and founds upon them the general law that decomposition is necessary to conduction.

Philadelphia, January, 1836.

*Abstract of a paper on the Naiades, &c.* By ISAAC LEA, Esq., Mem. Am. Phil. Soc., &c. &c.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—By direction of the American Philosophical Society, I send you an abstract of a paper on the Naiades, &c., the last part of which was read at the recent meeting of the society, February 5th, 1836. This continuation contained descriptions of the following new species.

Unio Zeiglerianus,	Unio simus,	Unio Hopetonensis.
“ Medellinus,	“ glaber,	“ Roanokensis.
“ notatus,	“ gibber,	“ lugubris,
“ Mühfeldianus,	“ Cumberlandianus,	“ creperus,
“ Tampicoensis,	“ pumilis,	“ Leontianus,
“ Carbonarius,	“ Jayensis,	“ Barnesianus.
“ Vanuxemensis,	“ folliculatus,	
Anodonta cylindracea,	Margaritana Holstonia,	
“ Wardiana,	“ fabula,	
“ salmonia,	“ deltoidea.	
“ Buchanensis,		

In the previous parts of Mr. Lea's paper, descriptions of the following new species were read to the society.

	Symphynota Bengalensis.	
Unio obscurus,	Unio solidus,	Unio porrectus,
“ Vaughanianus,	“ coccineus,	“ jejenus,
“ arctior,	“ Hydianus,	“ venustus,
“ pulcher,	“ turgidus,	“ interruptus,
	Unio lamellatus.	
Anodonta ovata,	Physa aurea,	
“ gigantea,	Paludina hyalina,	
Ampullaria Pealiana,	Melania plicata,	
Melania inflata,	Paludina pallida.	

Also, a new and interesting land shell, sent from Brazil, by Dr. Ruschenberger, for which Mr. Lea considered it necessary to form a new genus, which he calls *Megaspira*; the donor's name is given as the specific one,—*Megaspira Ruschenbergiana*.

Yours, &c.

A. D. BACHE,

One of the Secretaries Am. Philos. Soc.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Review of a "Geological Report of an Examination, made in 1834, of the Elevated Country between the Missouri and Red rivers. By G. W. Featherstonhaugh, U. S. Geologist. Published by order of both Houses of Congress. Washington: Printed by Gales & Seaton. 1835."*

(CONTINUED FROM p. 117)

Mr. Featherstonhaugh gives a pleasing description of the Hot Springs; it differs however in some respects from the account given of them in Mr.

James' History of Col. Long's first expedition to the Rocky Mountains, for Mr. J. states that the substance deposited from them is a siliceo-calcareous matter, which Mr. F. calls a travertin, or pure carbonate of lime; it would I think seem probable, that in a country where the silicifying process is so abundantly manifest, thermal waters, such as those of the Washita Springs, would contain silex; the difference however in these accounts is of little importance. Our author in speaking of the Washita oilstone, describes it as a silicious mineral, which he calls a novaculite; in this he differs from the generality of mineralogists who consider this latter mineral as a species of the argillite; whether therefore the Washita oilstone is a silicious stone to which the name of novaculite is improperly applied; or whether being a novaculite, he is mistaken in ascribing to it a silicious character remains to be determined. On leaving the Washita Springs, he continued his route to the Caddo river, and from thence to the Little Missouri, and mentions, that in the vicinity of the latter stream, he met with a "singularly black waxy soil of a carbonaceous colour;" as, independently of the singularity of its colour there is something unusual in such a texture of soil, it might be wished, that he had analyzed it, and given us some more particular account of its peculiarities. He next enters the Prairie country, and we are led to expect some interesting information on the subject of their geological character and origin, from his expressions of "sincere pleasure" at "finding himself upon geological grounds, with which he was well acquainted," (p. 74). His remarks on their geological formation are however very concise, being in a great measure confined to the observation, that he found the fossil shells in the Prairies identical with those of the New-Jersey green-sand formations: and as, in another place, he describes this latter formation as subcretaceous, by which I understand him to mean secondary; he must be considered as implying, that the prairies themselves are to be classed amongst the secondary formations; other geologists who have examined them have generally agreed in placing them amongst the tertiary,—a circumstance with which he must have been acquainted:—we may therefore, without pretending to determine which of these opinions is the most correct, be permitted to express surprise, that he should have omitted to state the reasons, which induced him to differ from the general opinion. He cannot, I think, be highly complimented on the success of his attempts to solve the much disputed question of the origin of the prairies. He states (p. 77) that he is "not of the opinion of those who think that all prairies have originally been produced by firing the timber annually, and thus, by repeated combustions, destroying the timber as well as the sprouts," but I believe no one acquainted with the prairies, or with the general condition of the country when inhabited by the Aborigines, ever entertained such an opinion, for had such a cause operated to produce the destruction of the forests, we see no reason why all the lands belonging to the Indians, with whom this practice was universal, should not have been converted into prairies. It is surely unphilosophical to admit that a cause insufficient in itself to produce a given effect, can, as he supposes, become sufficient, merely because no other apparent cause can be assigned for its production. We must therefore conclude, that no prairie has originated from these annual firings. Agreeing with him thus in a great measure, that prairies have not been thus formed, we may proceed to examine his notions of the actual cause of their production. He enumerates (p. 77) "amongst the efficient causes of a prairie" that "where the vegetable matter is thin, and the season unfavourable, plants

are liable to perish; and where they would not perish altogether, it must be remembered that this country was stocked with buffalo, which would by their periodical occupation of the country, assist in exterminating plants of a vigorless constitution." This is a strange method of accounting for the production of a vegetable growth, perhaps the most vigorous and exuberant of any in the world. But he has "another view of the subject," which he introduces by a postulate, "that the vast prairies of the west, as well as the diminutive ones in question, must be admitted to be the ancient floors of the ocean;"—as it is known to every one, who is acquainted with the first rudiments of geology, that the secondary and tertiary formations are generally believed not only to have been all covered by an ocean, but actually formed beneath its waters, he will find no difficulty in gaining assent to this position. But let us see to what purpose he applies it, when he goes on to say, (p. 77) that "when it abandoned them, they were, of course, without plants; and unless we admit their spontaneous growth, we must suppose them to have germinated from seeds derived from plants growing on lands, which had been left with a higher level than the ocean, before it receded from these prairies. Their borders would, of course, be planted first, and thus we can conceive of every new generation of plants giving some of its seeds to the winds and the waters, and gradually extending the forests, like the present members of the human family, advancing upon and settling the country for the uses of posterity."

Even if we admit that nature extends the vegetable creation over newly formed lands by this slow and gradual process, which is altogether contrary to our experience, we do not find his argument much to the present purpose; for he seems to have abandoned the prairies altogether, and to have applied his reasoning, if such it can be called, to the formation of the *forest* only, and as this is all the information he affords us on the origin of prairies, he cannot be said to have added much to the stock of knowledge on the subject.

Mr. F. mentions, on the authority of a gentleman acquainted with the country, that "plants," I suppose he means trees, "are encroaching on the prairies generally;"—this is an universal belief, indeed it is notorious, that in Kentucky, where they formerly covered a great extent of country, they are now nearly obliterated. He assigns as a reason for this diminution of their extent, the disappearance of the buffalo from the settlements of man; for he has observed, he says, (p. 76) that plants "encroach on the sides where vegetable matter has been washed and accumulated, finding a nutritious bed there, into which they can push their innumerable delicate fibres, secured from the devastating teeth and hoofs of the buffalo, which have now all left this part of the country." I do not see that his argument is, under any circumstances, very conclusive: but neither herds of buffalo, or any other wild cattle, when they roam in unrestrained freedom over the vast extent of the prairies in this country, or the pampas and llanos of South America, ever remain long enough in one place to produce any permanent effect whatever, on any part of the vegetation. The most satisfactory reason I have seen adduced for the diminution or obliteration of prairie land, is, that as the population of the country increases, new settlers generally establish their residence on the borders of a prairie, and their domestic cattle, being accustomed to be folded and fed at night, usually pasture in that part of the prairie adjoining their homes, they by these means keep down the growth of the grass so effectually, that when other parts of the prairie are burnt, on these places there is not sufficient herbage to afford fuel for the flame, and consequently they escape the action of the fire; and as the continued trampling

of the cattle, on such spots, checks the luxuriant vegetation of the grass, the seeds of forest trees, which are profusely scattered over them, are enabled to germinate and throw up their shoots without danger of being choked in their infancy by the superior vigour of the prairie grass, as happens to them in those other parts, where this latter plant, reigns uncontrolled master of the plain.

Having thus followed our Geologist through his tour, we may now examine what benefits are likely to be derived from it, either to the general cause of science, or the particular interests of the country; and that he may not complain of injustice, I will give the words in which he himself (p. 91) "enumerates its most interesting results."

The first is, "the establishment of the fact, from personal observation, of there being, in the state of Missouri and the territory of Arkansas, an amount of the ores of lead and iron of an excellent quality, not only more than adequate to any estimate of the domestic consumption of this nation, but such as may justify the expectation that it will form an important element hereafter of commercial exportation from that part of the world."

Now as the fact of the existence of these mines has long been known and never doubted, he cannot be said to have established it; nor has he furnished any data by which the quantity or quality of their produce may be estimated; it is therefore difficult to discover the advantage likely to result from any thing he has said on this subject, for his observations on it are neither calculated to charm by their novelty, or to excite interest by their scientific accuracy.

Secondly and lastly, he says, (p. 94) "I consider it also as a result of great importance, that the extensive investigations which I have so recently made, have gone, without exception, to strengthen the opinion I submitted to the Geological Society of London in 1828, as to the series of rocks in the United States, being the natural equivalents of that observed in Europe, from whence we may infer that the causes which operated to bring the rocks there into the particular order of superposition they preserve, have operated here, and probably have acted upon the whole crust of the earth."

Mr. Featherstonhaugh may himself be gratified by any fancied corroboration of formerly expressed opinions; but we have no evidence in the report itself, that this result, which he deems of so much importance, has been attained; and even if it had, it would seem to have been altogether foreign to the object of his mission.

It is very apparent that throughout his tour, he has been continually torturing his imagination with the attempt to identify the rocks of this country with European formations, which he seems to consider as the types to which all others are to be referred; and he has directed his efforts to establish this theory, rather than to study the true character and give a correct description of our own rocks. That the primary rocks of all parts of the world have a great similarity of mineralogical character, and that their geological position exhibits less variety, than that of later formations will be readily acknowledged; for they have undoubtedly all originated from the same cause, and as might have been expected, identity of cause has produced similarity of effect: that those rocks, likewise, which are frequently termed "Transition rocks" differ but little from each other in the different hemispheres, is perhaps equally true. But as we ascend in the series, it is evident from the very mode of their formation, that the secondary and tertiary rocks, in regions distant from each other, have each taken their character from local and independent circumstances which have destroyed that identity of mineralogi-

cal and organic character, and that perfect uniformity in order of position, which he wishes to claim for them.

Probably in no two primary ranges do the rocks of which they are composed, occur in exactly the same proportion, and even those rocks, particularly the granites, are subject to a variation in the qualities and relative quantities of their constituent minerals. The strata, therefore, which are formed by their disintegration are likely to assume a difference of mineralogical character, and no exact resemblance is to be expected, except in those of the same family, by which I would be understood to mean, those which originate from the same primary range; and the more distant any two correspondent strata in different families are from the parent rock, the greater is the dissimilarity between them likely to become. It is most probable, likewise, that each of these primary ranges was elevated above the level of the waters at different periods of time, consequently the formation of the subordinate strata in different families could not be synchronous, and from this cause, as well as from difference of climate, and zoological station, the fossil remains of organized beings found in them, may also be expected to exhibit dissimilarity; it becomes, therefore, difficult to establish any system of equivalency between strata differing in so many particulars. When, in the same family of rocks, two are found, not immediately contiguous, but occupying similar places in the series, and, though differing in mineralogical character, identified by a similarity of their organic remains, they may, I conceive, be called equivalents, as having been deposited during the same period, and such I apprehend to be the sense in which that term is used by European writers. But when it is employed, as it is by Mr. F. throughout his report, to express a relation between strata in this country and those in Europe, it is productive of confusion and error, and, till the true nature and character of the formations of this continent are better understood, can lead to no satisfactory result. He has nowhere told us, what he understands by it himself, and he uses it in such a desultory way, that it is difficult to collect his meaning, if indeed he have any. For instance, (p. 59) he speaks of finding in Arkansas, a red sand, stone resting upon grauwacke slate, and says he satisfied himself "that he was upon the true equivalent of the old red sand-stone and grauwacke of English geologists;" now such a formation as that which he found may be identical in its mineralogical characters with the sandstone and grauwacke of England, but I do not see how he can call them equivalents. Again he says, (p. 41) "when we add to the list the lignites, and the equivalent quadrupedal and saurian remains found in both countries," and (p. 76) "I have found the greatest profusion of the fossil equivalents of the genera peculiar to the green-sands of Europe." If these last named fossils were *peculiar* to the green-sands of Europe, we may wonder how they got into Alabama; and, in general, we may enquire, how, under such circumstances, any fossil remains can be said to be equivalent to each other; for if they vary in character or species, there would seem to be no relation between them, and if they are of the same species they are alike or identical. In the same way, he refers on two or three occasions, to Mr. Lyell's Eocene period; as when he says, (p. 39) he "found it in various parts of the territory of Arkansas," and again, (p. 62) speaking of a deposit of marine shells, he designates it in a note, to be "of the Eocene period of Mr. Lyell." The very lucid and beautiful arrangement proposed by Mr. L. for determining the relative ages of the different tertiary deposits, will doubtless greatly facilitate the study of them in all parts of the world, and

remove much of the ambiguity which has hitherto attended the line of demarcation between them, and the secondary strata; and as Mr. Conrad has observed, "although the tertiary formations in this country do not exactly correspond with those of Europe, there can be no objection to use their terms to designate them, as they apply equally well here as there." It requires, however, a perfect knowledge of fossil conchology, and an intimate acquaintance with the molluscan animals now inhabiting the waters and land of this vast territory, together with great patience of investigation, to enable any one to make a correct application of this system. Now, I would not be supposed to insinuate a doubt of Mr. F.'s conchological knowledge, but, as he made so brief and cursory a visit to the country he is describing, he must be aware that some incredulity may be felt as to the correctness of these off-hand assertions; an explanation of the reasons which led him to such conclusion, would, therefore, have been more satisfactory to men of science, and more instructive to a great portion of the "all," to whose intelligence he professes a desire to make his report *transparent*.

I would likewise suggest, that his geological phraseology is somewhat loose and indeterminate; for instance, he makes repeated use of the term "carboniferous," as applied to limestone, and as, in the commencement of his work, he professes to follow the improved Wernerian classification, which separates the strata into primary, transition, secondary, and tertiary classes, and in which we find no mention of a carboniferous group, some explanation of the term, if he chose to employ it, would seem to have been desirable; for unless defined by the adoption of the classification of Philips or Delabeche, it is singularly inappropriate, since, strictly speaking, all limestone is carboniferous. The use of the word "subcretaceous" is still more objectionable, particularly in a country where chalk is altogether wanting; indeed, I do not know from whence he has taken it; Delabeche uses the term "supercretaceous," to express the tertiary formations, but "subcretaceous" is not found in his system, and it does not appear whether Mr. F. himself intends to apply it to all the secondary formations, which interpretation it would certainly bear, or only to the green-sand formation of the Atlantic States.

The truth of his theory, respecting the greater antiquity of this continent, when compared with that of Europe, as deduced from the absence of some of the secondary strata found in that section of the globe, must be considered as questionable, till it is proved that the tertiary are actually incumbent on the primary or transition rocks, which, I believe, has not yet been, in any case, ascertained; for if they are not, they must rest on the secondary, and the only conclusion to be drawn, from the greater proportional part of the surface they occupy in this country, would be, that at the period of their formation, a great portion of the secondary rocks had not been raised above the waters of the ocean.

With regard to his pertinacious adherence to the dogma of European geologists, relative to the invariableness of the "constant succession in the order of rocks, in respect to their superposition to each other," (p. 42) I would only remark, that a study of the transition rocks between Baltimore and Cumberland, and of the coal districts and secondary rocks of the valley of the Ohio, would, in my opinion, convert the most staunch believer in such a doctrine, from so erroneous a faith.

His suggestion of giving the more determinate name of "Atlantic Primary Chain" to the range of mountains which traverses this part of the western continent, is worthy of notice, for certainly much confusion and

misunderstanding prevail from the names now so indiscriminately given to its different parts. His advice to the governments of the different states, to use caution in the selection of the persons to whom they entrust geological surveys, is likewise judicious, of which perhaps, no more convincing proof is requisite, than the perusal of this report.

Authors are said to feel a parental affection for the fruits of their literary or scientific labours, and the parental *στοργή* is frequently stronger in proportion to the weakness or deformity of the offspring. Mr. Featherstonhaugh may, therefore, think I have treated his bantling with undue severity; but, as every citizen of this country is interested in vindicating its literary and scientific, as well as its political character, I cannot refrain from the remark, that if a work, such as this, can be presented to the National Legislature of the American people, and by it be ordered to be printed, and thus circulated with the stamp of its approbation through the world; if it is extolled with the most adulatory encomiums by a great portion of the newspaper press, and receives no castigation in the pages of those journals, whose peculiar province it is to be leaders and guides in matters of science, it is time for America to abandon all pretensions to rivalry with Europe on such subjects, and sink at once into that station of mental inferiority, which has been sometimes so contemptuously and so unjustly assigned to her, by a certain class of transatlantic writers. P.

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## Franklin Institute.

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### *Annual Meeting.*

The annual meeting of the Institute was held at their Hall, on Thursday evening, January 21st, 1836.

THOMAS FLETCHER, Vice President, in the Chair;

J. HENRY BULKLEY, Rec. Sec. P. T.

The minutes of the last quarterly meeting were read and approved.

Donations of books were received from Messrs. J. Henry Bulkley, Henry Troth, Edward H. Gill, Christopher Wesener, Carey, Lea, & Blanchard, James Harper, Abraham Miller, C. B. Trego, and William Maclure, of Philadelphia; Edward P. Roberts, of Baltimore, Md.; and the Mechanics' Institute, of Manchester, England.

Major Hartman Bache presented a chart of Charleston harbour.

Mr. L. V. Badger, of Portsmouth, N. H., presented a model of a hot air forge.

Specimens of minerals and ores were received from Messrs. Thomas Pearson, John C. Trautwine, Captain J. J. Wheeler, Samuel V. Merrick, Samuel Tyson, Edward H. Gill, and John C. Cresson.

The Corresponding Secretary laid on the tables the periodicals received during the past quarter, in exchange for the Journal of the Institute.

Isaac Hays, M. D., from the Board of Managers, read their twelfth annual report, which was accepted, and referred, for publication, to the Committee on Publications.

The Treasurer presented his report for the last quarter, which was read and accepted.

Prof. A. D. Bache, from the Committee on Science and the Arts, presented a report of the transactions of the Committee for the past year,

which was read, and, on motion, was accepted, and referred to the Committee on Publications.

Mr. John Horton, from the Committee of Tellers appointed to receive the votes of the members for officers and managers of the Institute, for the ensuing year, presented their report of the result of the election; when the Vice President declared the following gentlemen duly elected.

JAMES RONALDSON, President.

ISAIAH LUKENS, }  
THOMAS FLETCHER, } Vice Presidents

JOHN C. TRAUTWINE, Rec. Sec.

ISAAC HAYS, M. D., Corr. Sec.

FREDERICK FRALEY, Treasurer.

*Managers.*

Samuel V. Merrick,	Joshua G. Harker,
Abraham Miller,	John Wiegand,
William H. Keating,	John Agnew,
Isaac B. Garrigues,	Wm. B. Reed,
Rufus Tyler,	Alexander M <sup>c</sup> Clurg,
John Struthers,	Joseph S. Walter, Jr.,
Matthias W. Baldwin,	Samuel Hufty,
Mordecai D. Lewis,	John C. Cresson,
Benjamin Reeves,	*James M. Linnard,
Alex. Dallas Bache,	*Andrew M. Eastwick,
Alexander Ferguson,	*Isaac P. Morris,
J. Henry Bulkley,	*Earl Shinn.

Prof. A. D. Bache, Chairman of the Committee on the Explosions of Steam Boilers, presented Part I of the report of the Committee. being the report of the experiments on the explosions of steam boilers, which, after reading the preface, was accepted.

Extract from the minutes.

THOMAS FLETCHER, *Vice President.*

J. HENRY BULKLEY, *Rec. Sec. P. T.*

*Twelfth Annual Report of the Board of Managers of the Franklin Institute.*

The Board of Managers, in surrendering to their constituents the powers with which they have been entrusted, have, as their last official act, the duty to perform, of laying before the society an account of its proceedings during the past year.

The great object for which the Institute was founded,—“the promotion of the mechanic arts,”—has been pursued with unabated zeal and assiduity. By means of lectures, schools, collections of models and minerals, a library, and a journal, information of the most valuable description has been disseminated to mechanics, and emulation among them excited, by premiums for the best productions of their workshops.

The Department of Instruction consists of a regular course of lectures on Chemistry, applied to the arts; one on Natural Philosophy, and occasional lectures on other sciences; a drawing school, and a school for elementary

instruction of apprentices. The lectures are, as usual, well attended; they are especially devoted to the instruction of mechanics in such branches of science as are of practical application in the exercise of their trades, and the advantages derived from them are strongly felt, and generally acknowledged.

The drawing school, under the charge of Mr. William Mason, and Mr. John Maclure, is at present in the most prosperous condition. The number of students admitted this year was so large, (sixty-seven,) that the room formerly appropriated to the school was found too small, and more ample accommodations have been furnished.

The collections of models and minerals, though still small, are highly useful for reference, and their future enlargement should be an object of constant and strenuous exertion.

The library continues to increase, and already embraces 1500 volumes. Of these, 199 have been added during the past year; 48 volumes by donation, 81 by exchange for the Journal, and 70 volumes by purchase.

The Journal of the Institute continues to grow in public favour, though its circulation has not yet become so extensive as its merits ought to obtain for it. The extension, however, recently sanctioned by the Board, which will contribute much to its utility, will also, no doubt, obtain an increased patronage. By the extension alluded to, mechanics will be furnished with more of the elementary matter they have desired than heretofore, while those who are devoted to scientific pursuits, will receive a full account of the progress of science here and abroad. To enable the Editor and Committee on Publications to accomplish this, the size of the Journal page is enlarged, so that one-sixth more matter will be furnished to the subscribers, and this without any increased cost to them. The Institute, it is hoped, will be remunerated for additional expense, by the increase of patronage which this arrangement will obtain.

The Committee on Science and the Arts have continued their useful labours during the year, with unabated zeal. On this committee are to be found individuals of the various callings embraced in the arts, and inventors who submit subjects to them are sure of a thorough, practical, and scientific investigation. The award of the Scott's legacy premiums and medals being made by the managers on the recommendation of this committee, improvements in the arts submitted, are rewarded, when of standard merit, by this testimonial, in addition to a published report. For the details of the transactions of this committee, the Board refer to the report of the Chairman.

The report of the Committee of Premiums and Exhibitions, will furnish you the details of the exhibition of domestic manufactures, held in October last. It is sufficient here to state, that the display was in all respects gratifying, and creditable to the skill of our artisans.

The Committee on the Explosions of Steam Boilers have completed the most important part of the experiments, instituted at the request of the Secretary of the Treasury of the United States, and have drawn up a report of the same, which the Board has ordered to be transmitted to the Department, and a copy of which will be laid before the society this evening.

The Board have, on the part of the Institute, paid the first instalment of \$15,000 to the masonic company; but this company not having been prepared to deliver up the premises, purchased by the Institute, at the period originally agreed upon, an arrangement has been made by which they are to retain possession until the 1st of March next, and allow to the Institute interest for the first instalment paid; and the payment of the second instalment, which was to have been made on the 1st instant, is post-

poned until possession of the property is given. An arrangement, under existing circumstances, advantageous to the Institute.

Two hundred and seventy-three members have been elected during the past year, sixty have resigned, and sixteen died; the number of members at present is 1921.

The funds of the Institute, as will be perceived by the Treasurer's report, which is annexed, are in a prosperous condition. The receipts for the past year were \$9,960 26, and, after honourably and promptly meeting all claims, as made, there remains in the treasury, \$3,065.13. The sinking fund amounts to \$12,013 43.

The Board cannot close their report without congratulating the society upon their prosperous situation. The success which has hitherto attended their efforts, evinces the judiciousness with which they have been directed, and affords a stimulus for continued and increased exertions for the advancement of the great objects for which we have been associated.

ISAAC HAYS, *Chairman.*

WILLIAM HAMILTON, *Actuary.*

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*Annual Report of the Transactions of the Committee on Science and the Arts.*

In pursuance of the directions of the Committee on Science and the Arts, I beg leave respectfully to present to the Institute, a report of the transactions of the Committee for the past year.

The Committee have examined, by sub-committees, during the past year, thirty-four subjects, or inventions, submitted to them, besides ten which were continued over from the preceding year. Of these, nineteen received favorable reports; six were judged worthy of the award of the Scott's legacy medal and premium; and three were withdrawn by those who presented them for examination, or the sub-committees discharged.

The premiums awarded from the Scott's legacy fund, during the past year, present a favorable view of the progress of some branches of practical science, which have hitherto not received contributions from our countrymen. Such was the award to Amasa Holcomb, of Southwick, Mass., for a method of mounting reflecting telescopes, combining the greatest simplicity with stability. To N. Bassett, of Wilmington, Del., for a compass for detecting and measuring local attraction. To W. A. Burt, of Michigan, for an ingenious apparatus for measuring the variation of the needle, to be used with the common compass, and remarkable for the facility with which it furnishes approximate results.

To Mr. Holcomb belongs the merit of having succeeded in making and polishing a speculum of eight inches aperture, which, when mounted in a front view telescope, gave highly satisfactory results. Double stars, 1.4'' and even 1.2'' apart, were divided by the telescope.

The mechanical inventions which received the award of a premium, were a shifting gauge cock, by Mr. Philos Tyler, of Philadelphia, and a knitting machine, by Messrs. M'Mullin and Hollins, of Sinking Valley, Pennsylvania. The former is a substitute for the common gauge cocks, the office of which it completely fulfils; it is simple in its construction, and very convenient. The knitting machine is necessarily complex, but performs its work very perfectly, and is well guarded against derangement.

The tinned lead pipes of Mr. Ewbank, which have received a similar award, will prove particularly valuable for water pipes, in situations where lead is corroded by the water passing through it. They are offered at a cost very little exceeding that of the ordinary lead pipes.

Although the rules in regard to the award of these premiums are handed to every inventor, who submits an invention to this Committee, and are published in the Journal of the Franklin Institute, some of the awards are yet imperfect, from the omission to present drawings, or models, of the inventions, as required by those rules.

Following out the principle to publish their reports, when the inventions submitted are brought before the public by patents, or otherwise, or when the publication is desired by the inventor, there have been published in the Journal of the Institute, during the past year, nineteen reports. There yet remain unpublished, but which have been ordered for publication, ten reports.

These proceedings show that the activity manifested by the Committee during the first year of its organization, has continued unabated during that just completed. The confidence of inventors in the counsel which it furnishes to them, seems, also, to have been undiminished. Thus, the design of the Franklin Institute, in the constitution of the Committee, is fully carried into effect.

The Committee have to regret the decease of one of their young and promising fellow members, Mr. J. Wilson Mitchell, deceased August 21st, 1835.

The number of the Committee is, at present, sixty-eight.

A. D. BACHE, *Chairman.*

January, 1836.

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## Mechanics' Register.

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### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN AUGUST, 1835.

*With Remarks and Exemplifications by the Editor.*

1. For a *Machine for Spreading a Solution of India Rubber upon Cloth*; William Atkinson, Lowell, Middlesex county, Massachusetts, August 15. (See specification.)

2. For a *Saw Set*; Theodore Taylor, Port Deposit, Cecil county, Maryland, August 15.

The setting with this instrument is not to be performed by a blow, as is usually done, but by the action of a lever, the long and short arms of which stand in a direction nearly vertical, there being two bends in it, at right angles, near its lower end, where the fulcrum is placed. Its lower termination is in a triangular face, adapted to the form of the tooth of the saw, which tooth is pressed between it and a suitable anvil, or bed piece, furnished with adjustments, to adapt it to different saws.

"Now, what I claim as new, and as my invention, is the angular lever by which the force requisite to set the teeth of the saw is applied to the trian-

gular foot; the strap, with the thumb screw and stops; also, the form of the rest, operating in the manner, and for the purposes, herein set forth. I do not claim the bevilled anvil, and foot for setting saws, but only in combination with the parts above claimed."

We have not seen this saw-set in operation, but, so far as the evidence before us justifies an opinion, we think it likely to answer better than most of those which have been previously patented.

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3. For a *Churn*; Joseph Turner, Poland, Cumberland county, Maine, August 15.

This churn has a formidable array of levers, rods, and connecting joints, by which two dashers are to be worked up and down in an oblong square box; we do not think it worth the space which would be required to describe it, or to furnish the claim; the former would show a complex mode of effecting that which has been repeatedly, and as well, done by more simple means; and the latter a variety of mistakes in supposing old things to be new.

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4. For a *Machine for Shelling Corn*; Joseph Turner, Poland, Cumberland county, Maine, August 15.

A vertical wheel, set with pins upon its face, is to be made to revolve, and the shelling is to be effected between this wheel, and a follower borne up towards it by spiral springs. There is nothing in the particular arrangement of the follower, as claimed by the patentee, to render it better than the analogous contrivances which have been used in the machines with vertical wheels of cast-iron. The claim is to "the follower, as made in three distinct pieces, and the application of the spiral springs to the follower, together with the slide separating the cob from the corn." This latter claim, so far as we can understand it, is for a thing without any novelty; but as it is not represented in the drawing, and the latter has no written references whatever upon it, a little obscurity may be expected.

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5. For a machine for *Dipping and Cutting Candle Wick*; William Morey, Charleston, Worcester county, Massachusetts, August 15.

We cannot pretend to describe the construction or action of this machine. as neither the specification nor the drawing furnish the means for doing so, We do not believe that a whole college of competent workmen would be able, with their united intelligence, to construct the apparatus from the description which these supply.

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6. For a *Cartouch Box*; Robert Dingee, city of New York, August 15.

The flap of this cartouch box is to be fastened to the body by means of a long metallic hinge, instead of depending upon the leather covering alone, which, by exposure to the weather, is said to become very hard, difficult to open, and easily broken.

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7. For a machine for *Hulling Grass Seeds*; Samuel Gould, Jr., New Portland, Somerset county, Maine, August 15.

This machine is to rub the seed between a cylinder and two hollow segments, all covered with perforated sheet iron. The cylinder is not to turn round, but to vibrate backwards and forwards, each of the hollow segments

embracing a quadrant, or more, of its lower half. The segments stand at a sufficient distance at the upper edges, to feed the machine. The description is not full, and there is no claim.

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8. For a *Cooking Stove*; Solomon Dixon, Richmond, Wayne county, Indiana, August 15.

This stove is intended for wood, or coal; we do not see any thing in it entitling it to special notice, although we do not know of any other in precisely the same shape, or having exactly similar shifting, or moving, parts.

"The improvements which are new, and for which I claim a patent, are the slides, the valve, with the cuts, or openings, in the diagonal plate, and the passage for the heat and smoke caused by the cuts, and in the vacuum below, in the semicircular box."

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9. For a vertical *Cutting and Press Machine for Books and Paper*; Benjamin Morris, Oxford, Chenango county, New York, August 15.

The cutting part of this machine is very similar to that of those in general use, in which a long knife is brought down vertically to cut the edges of books, or paper. The following may give some idea of the points of novelty claimed by the patentee.

"I have thus shown the construction of my vertical cutting and press machine in all its principal parts, and, in so doing, have described many things which I do not claim as of my invention; but what I do claim is, first, the attaching the knife by which the cutting is to be effected, to a separate frame, as shown in the drawing, which separate frame, with the knife, may be removed from the sliding frame, and again affixed thereto by means of thumb screws and buttons, for the purpose of sharpening the knife, without altering the setting or adjustment thereof. I claim, secondly, the general combination and arrangement of the different parts of this machine, as described, for the purpose of moving the frame of the cutting knife, and also of the frame for pressing; not intending, however, by this claim, to confine myself to the precise arrangement which I have exhibited, but to vary this as I may think proper, whilst I attain the same end by means substantially similar.

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10. For a *Machine for Splitting Shoe Pegs*; Mark Wilder, Peterborough, Hillsborough county, New Hampshire, August 15.

A vertical frame has, at its lower end, a cutting knife for cutting the pegs, which knife is attached to a vertical slide, that is operated upon by a toggle joint, worked by a bar, or pitman, in the usual way. The blocks, after having been pointed by a grooving tool, are placed upon a sliding bed below the knife, where they are secured upon a metallic disk adapted to receive them. The sliding bed is made to advance by the action of a feed rod, which receives its motion from that of the toggle joint, and slide. The grooved block must, of course, be adjusted to the knife, and must also be surrounded by a strap, to keep the rived parts together.

The claim is, to "the toggle joint, lever, and knife shaft, the revolving disk, and appendages, together with the palls by which the feeding is effected, the whole operating in combination for the purposes, and in the manner, herein set forth and described."

The claiming of the toggle joint, palls, &c., separately, is not a safe

course, as they are not the invention of the patentee; yet, by a fair construction of the foregoing, they are claimed individually, as well as in combination.

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11. For an improvement in Hubbard's *Rotary Pump*; David M. Walker, Cavendish, Windsor county, Vermont, August 15.

This might as well have been called an improvement upon a dozen other rotary pumps, as upon Hubbard's. Like the rotary pumps which have preceded it, it is difficult to make, and of little worth after it is made, as its operation depends upon the fitting of revolving pieces of metal to the interior of a drum, or cylinder, in which they revolve. Had the patentee been acquainted with the history of rotary pumps, as they have been known for upwards of a century, he would not have placed this upon record.

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12. For *Making Potash*; Elijah Williams, Harbour Creek, Erie county, Pennsylvania, August 15. (See specification.)

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13. For *Ships, constructed wholly of Iron*; Charles Olcott, Medina, Medina county, Ohio, August 15.

The only thing proposed to be changed is the material of which ships are constructed, as "no alteration is made in the *exterior shape*, or model, of vessels. The relative proportions of the hulls, masts, spars, and other parts of vessels, are to be the same, or nearly the same, in ships built on this plan, as before." In the claim, the patentee confines himself to the forms of the various individual parts, furnished with flanches, &c., for putting them together, "all exactly in the *manner* and of the *materials* above described."

The patentee states that the invention was made by him in the year 1815, although circumstances have caused him to delay the taking of a patent until the present time.

Steamboats, and various masted vessels, have, many years since, been made of iron. Masts for ships, also, have been constructed of the same material, and the question of adopting it in the building of sea vessels generally, has been a subject much discussed. Who first suggested the idea, we cannot tell, and it is likely that the thing is not known; but we are certain that it could be traced back beyond the year 1815. The mere building of ships of iron is not now, therefore, a legitimate subject for a patent, as the proposition is not new to the public. The exact construction, or form, of the individual parts, as described and claimed by Mr. Olcott, if new, is his; but this, without a claim to the system, will be of little value, and such a claim would, manifestly, be invalid.

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14. For a *Washing Machine*; Calvin H. Farnum, Norwich, New London county, Connecticut, August 15.

A cylinder is to revolve within a box, in the manner of the common dash wheels; the periphery of this cylinder is to consist of slats set in the manner of the buckets of a water wheel, in order that they may cause the suds in the box to pass forcibly into the cylinder. The box is to be enclosed, to keep in the steam; the lid at the top is to be of zinc, brass, or copper, and the gudgeons, and other metallic parts, are also to be of one of these substances, instead of iron.

"The invention claimed, is the improvement made in the above described

machine, by the use of a metallic top and lid; and the confinement and application of the steam; and the use of zinc, copper, or brass, gudgeons and boxes, and the arrangement of the floats of the wheel."

The metallic covering is injurious, defeating, by its conducting power, the very object for which it is professedly adapted; well fitted and arranged coverings and doors of wood are to be preferred. The substitution of the metals named for gudgeons and boxes, to avoid the danger from oxide of iron, is a thing well known; the form of the floats may probably be advantageous.

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15. For a *Machine for Sawing Shingles*; David B. Moore, Gilman-ton, Strafford county, New Hampshire, August 15.

In this shingle machine, the sawing is to be effected by a circular saw. The bolt, or block, from which the shingles are to be sawed, is confined on a carriage by proper hold-fasts. A shifting motion is described, by which the thick and the thin ends of the shingle are alternated. Many of the parts are much like those used in other shingle machines, and the claims, therefore, are limited to the particular modes of construction devised and described by the patentee.

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16. For a *Machine for Making Bricks*; George W. Gilbert, Pitts-burgh, Allegheny county, Pennsylvania, August 15.

The machine here patented is accompanied by a drawing, sufficiently well executed, so far as it goes; and it might probably be found sufficient for its purpose, if the specification were such as to fulfil its share of the business of description; this, however, is altogether defective, containing little more than a mere catalogue of the respective parts. It ends with a claim to "the arrangement and adaptation of the several parts of the before described machine for making bricks, particularly the wheel of moulds, the pistons, guides, pin, and lever, and the spiral cam for moving the wheel of moulds."

The *wheel of moulds*, which is *particularly* claimed, is not new, and the individual things enumerated may be important as making parts of a combination, but, taken by themselves, they are trifling, and not fit subjects of a claim.

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17. For *Bricks for Fire Proof Roofs*; James Parker, Gardiner, Kennebec county, Maine, August 15.

These bricks are rhomboidal at their ends, so that when their flat sides are placed horizontally, their edges will have the same inclination with the intended roof. This comprises all the information necessary respecting their shape. To form a roof they are to be laid on laths, or on smooth boards, as may be preferred, when they will present a smooth and even surface. The claim is to "the peculiar form of the bricks, and of the mould in which they are to be made; and the application of bricks to the purpose, in the manner described."

Without animadverting upon the claim, we will observe that the use of tiles is objectionable on account of their great weight, which renders it necessary to frame the roof, and to build the walls with corresponding strength. How it may be with the houses in Maine we know not, but in most parts of the union the roofs and walls would not sustain the load which it is here proposed to put upon them, and to enable them to do so would cost more than metal roofs, which are incontestibly superior in all respects to those of brick.

18. For a *Press for Cotton, Hay. &c.*; Ebenezer Macomber, and Laban S. Macomber, Gardiner, Kennebec county, Maine, August 15.

This press is peculiar in the mode in which it is acted upon, which is by levers applied by hand to teeth on a vertical piston, or shaft, on the top of which is the follower. The main lever used for the purpose must correspond in length and in stoutness, to the power with which it is to act. Upon the bottom, or platform, of the press there are boxes of cast-iron which have ridges upon them serving as fulcra to sustain the lever; these fulcra are movable, so that the power applied may vary with the resistance. The distance gained by raising the piston is retained by wedges which slide forward by the action of a weight, passing over a pulley. The whole appears to be skilfully arranged, and we have been informed that in packing cotton it has performed considerably more work with the same power than any of the presses known in the neighbourhood of the place where it was erected; an effect which appears to be due, principally, to the little friction to which it is subjected.

We do not give the claims, as they refer not only to the general arrangement, but also to certain particular parts which we cannot take time to describe.

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19. For *Machinery to facilitate Evaporation*; John Goulding, of Boston, and Reuben Brackett, of Lynn, Massachusetts, August 15.

This patent is obtained for "machinery for facilitating the evaporation of solvents, or fluids, and in various water proof compositions or mixtures, from the cloth or other substance to which said mixtures or compositions may be applied, and also for condensing the same again, or converting them from an aeriform into a liquid state."

The cloth coated with a solution of India rubber is to be wound upon a roll in such a manner as to allow it to form a spiral with a space between each coil. The reel and the cloth so wound on it is then to be enclosed in a box, or case, of wood or of metal, fitting together so perfectly as to prevent the entrance or the escape of air. From the top of this case, or box, there is a tube leading to a condensing apparatus of any convenient form. Heated air, or steam, is to be admitted into the case, either through the axis of the reel, if made hollow for that purpose, or through any other convenient opening, the effect of which will be to evaporate the volatile solvent. The claim is to the accomplishing this object, and to the collecting of the solvents by the means described.

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20. For a *Stove for heating Tailors' and Hatters' Irons*; John Lewis, Derby, New Haven county, Connecticut, August 17.

A cast-iron furnace is to be made to contain anthracite, and under this there is to be an ash pit. Around the furnace, or "chamber of combustion, are placed several linings of sheet-iron, about an inch apart, forming air-tight chambers enclosing columns of *fixed air* (?) to prevent the lateral escape of the heat." There is to be a cover to the stove, which is to be an "air-tight chamber formed by several linings of sheet-iron or tin, enclosing columns of *fixed air*, to prevent the escape of the heat into the room." The claim is to "the application of fixed air chambers around a stove for the purpose of heating tailors' and hatters' irons; at the same time preventing the heated air being transmitted into the apartment in which the stove is placed in the manner before described.

By *fixed air*, we suppose is meant air fixed within the chambers. The

apparatus itself, we apprehend, will be more costly than a small brick furnace built for the purpose, without being more convenient.

21. For the application of *Water Lime Cement to the Construction of Roads*; Joseph Roby, Jr., Albany, New York, August 27.

The whole system contained in this specification is that so well known of forming roads by the employment of hydraulic lime with beds of gravel, or broken stones of a suitable quality; the directions given do not contain any thing with which engineers are not familiar, and the patentee tells us, in conclusion, that "he would add to his specification and claim, the right to construct roads, streets, &c., by the use of water lime or cement, in any other manner than above described," a right which will be very readily conceded to him, provided it be not an exclusive one; to this both the ancients and the moderns may well demur. Our shelves would furnish a volume of evidence of the antiquity of such roads; we have opened the "*Dictionnaire Technologique*" only at the article "Cement," and give the following note: "I have very recently had occasion to examine a piece of natural hydraulic lime, from which a hydraulic mortar of great excellence is prepared, and which is principally employed in the construction of cement pavements of very great solidity."

22. For a *Churn*; Caleb Angerine, City of New York, August 17.

Mr. Angerine obtained a patent for a churn some time ago, and although he has a new patent he has not a new churn, as this last is a fac simile of such as were previously on the shelves of the patent office. Two churns of the ordinary kind are placed upon a platform, the two dashers are attached to a vibrating beam, to which motion is communicated by a crank, aided by a fly wheel. The patentee claims "the application of the *walking beam, fly wheel, pendulous lever, operating crank and pitman*, in giving motion to one or more churns at once.

23. For a *Harpoon*; Dexter N. Chamberlain, Boston, Massachusetts, August 17.

The patentee says, "What I claim as my invention is the introduction of prussic or hydrocyanic acid into a harpoon, for the purpose of destroying whales or other fish, or animals usually taken by that instrument, and furthermore I claim the construction of a harpoon as I have herein above described."

We do not dispute the fact of the patentee being the inventor of the use of prussic acid for the purpose designated, but if he was, he has been unfortunately dilatory in applying for a patent, as two or three years have elapsed since we were in correspondence with other individuals upon the same subject, and the taking of a patent was then declined because it was found that the idea was not new. The public papers have noticed it, long since, and it can scarcely, therefore, be called *new*, at the present day.

24. For a *Wire Door Spring*; John Codman, Boston, Massachusetts, August 17.

The spring is called "the vertical tortine, wire door spring," and a patent was obtained for it on the 10th of December, 1832. The regulating box and wheel described in the former patent have been improved, and this forms the subject of the present application; a semicircular groove is to be made in the

box and wheel, the object of which we cannot take time and space to describe.

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25. For the *Application of the Waste Heat from Forges, Furnaces, &c.*; Tunis Leroy, Newport, Herkimer county, New York, August 17.

A steam boiler is to be so placed as to receive a due portion of the waste heat of forges, furnaces, &c., by which means a power is to be obtained which is applicable to various useful purposes. The doing this is the thing claimed. Owing to the great increase in the number of patents, we do not so frequently as formerly, turn to day and date to show when, and how often, patentees have been anticipated in their inventions. Our own patent office, and the establishments in foreign countries, might both be appealed to in proof that the foregoing possesses no claim whatever to novelty.

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26. For an improvement in *Power, and other, Looms*; Amasa Stone, of Rhode Island, but now residing in England, August 17.

In the specification of this patent particular reference is made to one formerly obtained by Mr. Stone, and dated the 13th of April, 1829, and upon which the present plan is to be considered as an improvement. After explaining the construction of his apparatus, by reference to drawings, the patentee says that, "having now described my improvement in power looms, and other looms for weaving silk, linen, cotton, woollen, and other cloths, called a taking up motion, together with the arrangement of parts by which the same may be carried into effect, I do hereby declare that I consider my claim of improvement or invention to consist in and extend to the connection of the reel with the cloth beam (in those looms where my former improvement already referred to is applied) and in the communication of motion from one to the other, and in the regulation of the motion of the cloth beam by the motion of the reed, by whatever combination of machinery, apparatus, or gearing, the same may be effected."

The object in view, and the general means of attaining it, appear to be similar to those of Mr. Burr, in the patent numbered 31, for the last month, (July.)

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27. For *Gates for Canal Locks*; David Wilkinson, Cohoes, Albany county, New York, August 17.

There is a good general drawing of the apparatus patented, but the description and claim lend little or no aid in making known the views of the patentee. The latter is as follows:

"The invention claimed consists in the before described mode of adjusting the friction roller, for the quadrant, or circular rail ways; the rider to guide the chain on the capstan; the open head with palls of the capstan, and the self-adjusting valve gate."

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28. For *Winding Silk from the Cocoons, without Reeling*; Gamal-iel Gay, Poughkeepsie, Dutchess county, New York, August 17.

The particular construction of this machine is shown in a drawing which accompanies, and is referred to in, the specification. The claim is to "the winding of silk from the cocoons directly on to the spools, without the intermediate process of reeling; and also to that arrangement of the winding machinery by which the same is, or may be, effected, acting substantially as set forth."

29. For a *Mowing Machine*; John P. Chandler, Wilton, Kennebec county, Maine, August 17.

The frame work of this machine runs upon four wheels, three of which turn freely on their axles in the usual way, but one of the hind wheels is employed to give motion to the mowing apparatus, by means of a wheel and band. The scythes, four in number, are attached to the periphery of a wheel which revolves horizontally below the body of the carriage. In this specification there is nothing in the form of a claim; the general principle is not new, nor does the arrangement of the parts of the machine offer any thing to bespeak a more favourable opinion of its operation than of that of several others of the kind which have had a brief existence, and then passed into oblivion.

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30. For a *Spiral Band Wheel*; Samuel S. Walley, Charlestown township, Chester county, Pennsylvania, August 17.

The title of this patent led us to suppose that a band twisted spirally was to be employed upon a wheel; but as in books, so in patents, the title and the contents have sometimes but little connexion with each other. The patentee has conceived a notion that he can obtain a great increase of power by passing a band over polygonal or angular wheels; and we have a notion that if he ever attempts to use a band in the manner described by him, his example will not have a single follower. A description of the affair is out of the question; we must omit that and pass to the claim, which is to "the above described combination and structure of machinery applied so as to produce an increased power or effect from the increased adhesion of the band by its coiling one or more times upon an angular conical cylinder, or wheel, adapted for the purpose as aforesaid; and, by the employment of a square hole with rollers, as a means of transmitting the band, and communicating circular motion from a perpendicular to a horizontal wheel, and vice versa, without the intervention of intermediate wheels as aforesaid."

If the reader does not understand the whole from the foregoing, it would be of little use to present the entire specification and drawing, as these would involve him in inextricable darkness.

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31. For a *Machine for Breaking Anthracite Coal*; Jonathan S. Hubbell, city of New York, August 17.

This is a machine to effect that which we are very apprehensive must continue to be done by hand. The coal is put into a kind of trough, the bottom of which is formed of iron bars, or grating; and hammers, or beaters, are made to rise by a revolving shaft, and to strike upon it. It is proposed to place an inclined screen below the trough to divide the coal, and we believe that this will be a very useful appendage, as we have no doubt that a large portion of it will be well pulverized, and that the remainder will be very unequally broken.

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32. For *Grinding and Chopping Grain*; Pierson Cope, Washington township, Fayette county, Pennsylvania, August 17.

This is merely a mill with a conical nut and box, the axis of which is placed horizontally, the feeding being effected through an opening in the shell at the small end. The claim is to "the plan of the castings; the plan of the furrows that they may grind fast with little power, and discharge freely through the opposite end, and the plan of tempering screws with the iron

slides, and putting it together for convenience;" each of which plans has about an equal claim to novelty.

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33. For a *Pocket Pistol*; Victor M. Wallace, West Topham, Orange county, Virginia, August 17.

The object of this invention is "to give the greatest length possible to the barrel of the pistol, for the purpose of discharging the ball with increased velocity and greater precision in its direction, as well as to a greater distance." To effect this object the back end of the barrel is cylindrical, and is passed into the stock, reaching to its end, the part grasped by the hand descending nearly at right angles from the upper portion. The percussion cap passes on to a nipple at the centre behind the barrel, the trigger operating upon it through the intermedium of a main spring and other appendages, contained within the handle of the stock.

The claim "is not to the discharge from the centre of the breech-pin, but simply to the manner of construction described, namely, the rounded back part of the barrel, with the manner in which I insert the breech pin, for the purpose of drawing the shoulders of both towards each other; also the disposition of the lock, as contained in the lower part of the grasp of the stock, also the interior of the trigger, and its adjustment as described."

There is some sacrifice made by rounding the back part of the barrel, as the breech is thereby rendered smaller than the outer, or muzzle, end; perhaps, however, means may be found to remedy this defect.

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34. For a *Cooking Stove*; Ezekial Gore, Jr., Guilford, Windham county, Vermont, August 17.

Here is a rectangular box which is divided into three compartments; the two end ones are ovens with doors, the middle contains the furnace, the upper end of which extends through the top of the box, where it is fed with fuel, and through which passes a tube leading into two boilers which stand on either end of the box, above the ovens. We do not think it worth while to give the claims as the thing is old in nearly every part; it is not long since a patent was granted for a stove nearly identical with this even in its minutia.

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35. For the *Application of the rising and falling of the tide to the propelling of Machinery*; Henry B. Fernald, Portsmouth, Cumberland county, Maine, August 17.

"A buoy of sufficient strength and dimensions, connected by a rope or chain passing from the buoy under a pully at the bottom of the water, with a wheel which moves the machinery. In the falling of the tide, or water, the weight of the buoy, filled with water by means of a stop cock, or otherwise, operates as a propelling power, being so connected by another rope or chain to another wheel, as to operate alternately with the wheel above-mentioned."

"What I specifically claim as my invention or discovery is the principle of applying the rising and falling of the tide, and other water, to the propelling machinery."

At p. 154, vol. 5, there is the specification of a patent granted on the 23d of December, 1829, to Henry M. Webster for a "tide power," in which it is said that "the object which the subscriber proposes to effect is to bring into value and use the rise and fall of the tide on the seaboard, and particularly

in the principal cities of the Union, to be employed in manufacturing and other purposes."

The two plans, it will be seen, are identical; in the first patent it is proposed to use "vessels or floats of great weight and buoyancy," "a condemned or other hulk of a ship of required size," being mentioned as suitable for the purpose. Some remarks of the editor will be found appended to the specification alluded to.

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36. For a *Lady's Saddle Tree*; John M. Bouton, Newark, New Jersey, August 17.

All the information given in the specification is that there is to be "a safety guard or rail extending from the head of the cantle, made from steel, iron, wood, or any other material, and secured at the two ends to the saddle tree by loops, sockets, rivets, nails or screws. The safety guard runs from the head to the cantle in a circular form, and is especially useful in securing the seat of the rider, and making them sit firmer and more safe."

Although this specification appears to be the work of a gentleman of the law, its requirements have been either misunderstood or overlooked, as the foregoing, most certainly does not distinguish the invention from all other things before known or used, nor set it forth in those full clear and exact terms which will enable a competent workman to make the thing intended to be described.

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37. For a mode of *Fitting the boxes for gudgeons into the plummer blocks; and also the bearing of the slides for Locomotive and other Steam Engines, and for other purposes*; Matthias W. Baldwin, city of Philadelphia, August 17. (See Specification.)

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38. For *Preparing of the Oil of Harze*; Christopher Preswick, and John M. Fisher, city of New York.

"The object of our invention is to prepare an essential oil from the condensable matter, or overflow, which is obtained in the manufacture of carburetted hydrogen gas, from resin-wood or bituminous coal, or a mixture of them, and the said oil may be applied to the following purposes; that is to say, in the preparation of paints, varnishes and laquers, also as a solvent caoutchouc (or gum elastic); also for furnishing light in lamps." The condensable matter is to be mixed with animal or vegetable charcoal, and then submitted to distillation, the volatile oil being condensed. The claim made is to the effecting this object, in the manner proposed.

The tar, or condensable matter collected in making carburetted hydrogen from pit-coal is regularly submitted to distillation in England, and the essential oil, a species of naphtha, obtained from it is employed in dissolving caoutchouc, and for other purposes; yet this, according to the terms of the foregoing patent, appears to be one of the objects which the patentees claim as their own invention.

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32. For a *Machine for Sowing Plaster, Lime and Ashes*; Julius Notch, Great Bend, Susquehanna county, Pennsylvania, August 17.

A long trough, or box, divided into separate compartments, resembling so many small hoppers placed in a line with each other, is to be mounted on wheels, and to be drawn forward in the manner of a cart. The sides of these troughlike hoppers are inclined towards each other as they approach the

bottom, where they are only an inch or two apart; a rod extends from end to end of the opening, and partially closes it. The material to be scattered is put into the trough, or hoppers, and a longitudinal, vibrating motion is communicated to the above named rod, which has teeth, or pins, on it, to agitate the plaster, &c., and cause it to be scattered. The machine is badly described, and the claims made confine the patentee to the particular mode represented of effecting his object; they are to "the arrangement and adaptation of the crank, crank-rod, elbow, and horizontal rod, arm, and sliding rod, with its teeth, together with the regulating gauges, as described." It would require but little mechanical skill to construct a machine to answer all the purposes of the foregoing parts without using either of them "as described."

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40. For an improvement in the art of *Making Brushes*; Wm. Steel, city of New York, Aug. 17.

The stocks are to be prepared as usual for set, or drawn, work, and the setting, or drawing, is to be effected in the usual way; the difference between them and other brushes consisting in the substitution of feathers for bristles. The feathers are sometimes to be used by doubling them in the middle, so that the quill, as well as the feather end may project out; the quill end, if desired, may be split, or divided into several ends. In other cases the quill ends are to be inserted within the stock. "This applicant claiming the exclusive right to the mode of constructing brushes of feathers, for the following uses, viz: for dusting brushes of all kinds, hearth brushes, water brushes, and hair brushes of all kinds. This applicant contemplating the application of the principle of this improvement to the construction of all kinds of brushes which may be made of feathers instead of bristles."

The title of this patent is incorrect, as the improvement is not in the *art* of making brushes, but in the employment of a new material; it is therefore, properly, a new manufacture.

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41. For an improvement in the *Screw Wrench*; Solyman Merrick, Springfield, Hampden county, Massachusetts, August 17.

In this screw wrench the sliding jaw is not drawn back by turning the handle, as is usually the case with those imported, but the bar which is at the back, and makes a part of the sliding jaw, is acted upon by a nut which swivels in it, and turns upon a double threaded screw, extending from the oblong square part upon which the sliding jaw moves, to the handle, which is of wood. The nut is made octagonal, and is easily turned by the thumb and finger. The claim is limited to the arrangement of the screw and nut, which we believe to be new.

These articles are manufactured by N. Foot & Co., Springfield, Massachusetts; we have seen them, and can aver that in point of construction and of workmanship, one of them is worth several of the best imported wrenches.

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42. For a *Vapour Bath*; Pierre Paul Noël D'Alvigny, city of New York. An alien, who has resided two years in the United States; August 17.

We have here a long story about the construction and use of this vapour bath, after perusing which, we are no wiser than we were before we commenced the task, the whole system adopted, being such as is well known, both in this country, and in Europe. The patentee claims "the manner in

which he has combined and arranged the several parts described," which, with the exception of such variations as would be made by any two persons forming a similar establishment, presents, as we have said, nothing new.

43. For an improvement in the *Saw Mill Saw*; Levi Fisk, Schroon, Essex county, New York, August 17.

Every third tooth of a saw mill saw is to be sharpened to a cutting edge on its upper side, the teeth so sharpened being alternately on reverse sides of the saw; these teeth are then to be so set as to cause them to take a thin shaving off in their ascent, and thus to plane the sawed stuff, or to render it much smoother than is done by the common saw. It is said that experience has shown that the best effect is produced by so sharpening every third tooth, although an adherence to this number is not absolutely necessary. The claim is, to "the *upper oblique* edge of saw teeth being cut to the right and left alternately, and set together, or betwixt any number of common teeth, for the *upward* motion of the saw, for the purpose of sawing wood in a smooth manner, as above described."

44. For a *Churn*; Clifton C. Stearns, Bucksport, Hancock county, Maine, August 17.

This churn is to have a vertical shaft, to which a revolving motion may be given, by means of a winch and bevil gearing. The dashers which project from the shaft, are to stand at an angle of about  $45^\circ$  with it, which, it is said, will give a tendency to the butter, as it is formed, to accumulate about the centre, thereby improving it, and causing the churn to work with the greater ease. The claim is to "the plan, or principle, of giving the dashers an oblique position, by which the butter, when formed, is thrown or accumulated in the centre of the churn."

45. For a *Pendulum Level*; Asahel Munger, Oberlin, Lorain county, Ohio, August 17.

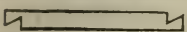
"This improvement consists, principally and especially, in attaching a tube, or a straight bar, with a sight at each end, to the top of a pendulum, in such a manner as to admit of its being arranged or adjusted, either by screws, or otherwise, at right angles with the pendulum, and may be suspended within an enclosure of any kind, which shall protect it from the influence of currents of air."

We have been in the habit of supposing that those persons who use levels, sometimes read books on the subject of surveying, engineering, &c.; but we find that this must not always be assumed. The pendulum level has been mentioned and exhibited in a thousand books, in all the languages of civilized nations. It is to be seen, with the pendulum enclosed, in *Leupold's Theatrum Machinarum*, in plate 3, vol. iii., published in 1724; how long it had been then known, we have not taken the trouble to ascertain. Its merits, or rather its demerits, have been a matter of frequent discussion.

46. For a machine for *Planing and Matching Boards*; Fisher Stedman, Acquackanockin, Essex county, New Jersey, August 17.

The specification of this patent is equally laboured and obscure, yet it is manifest that the writer has desired to make it plain. It seems as though the model had been depended upon to make the machine known, as the drawing, although on three sheets of paper, can scarcely be said to illustrate

any thing. Toothed wheels, revolving cutters, saws, &c., &c., are all represented by simple lines, so that the man who should attempt to make the machine, must invent it in all its details. We learn, however, after much labour, that boards are to be planed by a round horizontal cutter wheel, under one side of which they are to be passed, by the aid of pressing rollers. The matching is to be by a dovetailed joint formed by horizontal cutters, which take away half the stuff on opposite sides towards each edge, thus,



if we understand the thing correctly. The claim is to "the whole apparatus and combination of machinery by which the board is traversed by the cutters in dressing the surface, and by which the edges are matched in the dovetail form, as described above, and is the invention for which a patent is now prayed."

The first part of this claim is altogether untenable, the dressing of boards by traversing cutters, in the way described, having been practised in numerous instances. Dovetail cutters were used at the navy yard in Washington, sixteen or eighteen years ago, for matching wharf timbers, and they were not then new; still, in the combination with the other machinery, had that not been altogether old, it possibly might have been sustained.

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47. For an improvement in the *Manufacturing of Chairs*; Eli F. Benjamin, Utica, Oneida county, New York, August 17.

A machine is employed for the purpose of boring the different parts of the chair which are to be connected together, as all the chairs made upon the plan of the patentee are to be put together by dowells. The machine has a shifting top, upon which the pieces to be bored are secured by proper means, the movements of the top admitting of giving the proper rake in all directions; there are, attached to the frame, two spindles, running like lathe spindles, to receive the bits to be used. The claim is to "the putting chairs together by or with dowells, and the described form of machinery for expediting every part of the work."

The model is referred to throughout the specification, which is a very gross error, though by no means an uncommon one. A drawing is given, but it does not furnish the details of the "described form of machinery;" to an ingenious workman, this, it is true, would be a thing of little consequence, as he could easily construct the required apparatus without trenching upon the claims of the patentee.

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48. For a *Rarefied Air and Rotary Motion Steam Engine*; George Cameron, Washington city, August 17.

This is one of the oldest and worst species of engines ever made, as its power is to be derived from blowing the steam on to the buckets of a wheel. Much stress is laid upon the using of a forked pipe, leading to opposite sides of the wheel, and furnished with stop cocks, to reverse the motion. The rarefied air part consists of a similar wheel, on to which the rarefied air from the furnace chimney is to be directed. We would propose as a motto for this, "*de pis en pis*."

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49. For *Preparing and Hatcheling Hemp, Flax, &c.*; John Goulding, Boston, Massachusetts, August 19.

In this machine, the hemp is to be laid in a trough, in small handfuls, and carried forward by a feeding apron, between feeding rollers, which deliver it on to a large hatcheling cylinder, set with suitable teeth, between which

it is pressed, so as to lie closely on the cylinder, by means of a reel-like roller, the longitudinal wires of which mash between the wire teeth. After passing under this cylinder, the hemp is raised, by a contrivance for that purpose, upon a second cylinder, revolving about seventeen times more rapidly than the former, and, of course, drawing out the fibres. From this second cylinder, it passes through a trumpet-mouthed tube, between rollers, and into a can. The slivers from ten, or any other convenient number, of such cans, may afterwards be passed together through the same circuit, and this may be repeated as often as may be thought necessary.

The claim is to "the above described mode of hatching hemp, flax, tow, or Manilla grass, and producing thereby a continuous strand, or sliver." We think that this claim is in terms too general, unless it can be made to appear that the machine is new in all its arrangements, as applied to the purpose for which it is to be used.

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50. For an improvement in the *Endless Chain Horse Power*; Benjamin Wales, Hallowell, Kennebec county, Maine, August 17.

The main dependence for sustaining the slats of this horse power, is the construction of the links, or hinges, by which they are connected together; various forms of the stop hinge joints, or self-supporting arches, have been devised for the same purpose, but they are all insecure, depending too much upon the strength of each individual joint. The patentee claims, "the modes of forming the hinge, and the peculiar form of the link; the forming of the end wheels with lips and projections; the mode of communicating power by the projections of the chain fitting into the indentations between the projections of the wheels; and the mode of sustaining the chain, and keeping it in its place by means of the railway and small wheels, as described." The novelty of some of these things is more than doubtful.

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51. For *Medicine for Cholera*; Robert S. Bernard, Norfolk, Norfolk county, Virginia, August 17.

Take

Sulphate Alumine,	. . .	2 grains.
Sup. Carb. Potassa,	. . .	1 "
Alcohol, 80° above proof,	. . .	40 drops.
Gum. Camphor,	. . .	20 grains.
Hoffman's Anodyne Elixir,	. . .	$\frac{1}{2}$ oz.
Compound tinct. Opium,	. . .	$\frac{1}{2}$ oz.
Sp. Lavender,	. . .	1 oz.
Pure water,	. . .	3 oz.

A table-spoonful of the mixture in as much water, to be taken every hour, or half hour. For children, in proportion.

This is to cure Asiatic Cholera, Cholera Morbus, and Diarrhœa.

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52. For a *Cooking Stove*; Edward N. Kent, Portland, Cumberland county, Maine, August 17.

The patentee finds much in this stove to commend, and we have no doubt that a good dinner may be as well cooked by it, as by many others; there is not enough of novelty in it, however, to render any particular description necessary; the claims are, to "the damper for dividing the draught each way, and its rack; the *form* in which the stove is made to cook so many different ways, with less fuel and trouble than is caused in other stoves, I do not

claim." Less could scarcely have been claimed, but still we believe it will be found that even this little is more than is really new; dampers, or valves, having been used in various ways, to divide the draft, and to direct it over, under, or around, an oven, much in the way described in the present instance.

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53. For *Covering Houses with Sheet Tin, &c.*; Charles Bonnycastle, Charlottesville, Albemarle county, Virginia, August 17.

This patent is taken for improvements on the plan for which a patent was obtained by the same gentleman, on the 29th of June, 1833. The object aimed at is a simple and easy mode of fixing the roofing of buildings, so as to allow a free play to the expansion and contraction for which it is subjected, both longitudinally and laterally. The particular way in which this is effected, would require a cut for its explanation.

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54. For *Destroying Weevils, and other Insects, and their Eggs, in Grain; to Expel Moisture from Grain, Meal, and Manufactured Flour, and for Drying Malt*; James A. Lee, Maysville, Mason county, Kentucky, administrator of James Lee, deceased, August 17. (See specification.)

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55. For a *Machine for Serving Ropes, or Rigging*; James Fales, New Bedford, Bristol county, Massachusetts, August 20.

A perpendicular frame is made capable of traveling upon rollers, and at a convenient height from the floor; upon this frame there is a cog wheel with a tubular shaft, which wheel is so made that a portion of its rim, say one-fourth, or one-third, may be removed, for the purpose of admitting and removing the rope to be served, and again firmly fixed in its place. A rack, containing a reel for the serving yarn, is placed behind the wheel and hollow axles. In using this machine, the rope, after being passed through the tube, is stretched *taut*; the yarn, by the aid of a serving mallet, is passed around the rope in the usual way, and motion being then given to the wheel, by proper gearing, the serving is expeditiously performed. The claim is to "the above described combination of machinery, and its application to the purpose of serving ropes, or rigging."

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56. For an improvement in the *Grist Mill*; Adna L. Norcross, Hallowell, Kennebec county, Maine, August 20.

There may be an improvement here, but in what it consists we do not know, as the drawing, which is referred to, is a very poor affair. We learn, however, that the runner, of twelve inches in diameter, is to be fixed upon a horizontal shaft; that the bedstone, which is square, is to be grooved out to receive the runner, and that a small groove on the upper side of the bed stone is to admit the grain. The claim is "to the peculiar form and manner of constructing the mill stones, together with the general arrangement of the machinery."

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57. For machinery for *Spinning Hemp and Flax*; Andrew Caldwell, Lexington, Fayette county, Kentucky, August 20.

The patentee says that, "by the machine I have invented, and the improvements upon the spindle, (which requires one hand to each spindle,) I am enabled to spin twice as much yarn as is now spun by one hand in the

ordinary mode, besides having brought the operation of spinning into the compass of a room, and adapted it to a new source of labour, old and young, male and female." He does not, however, make any distinct claim, but leaves it to be inferred, from the general description, in what his invention consists. A number of figures are given in the drawings, and we cannot afford the space which without these would be required to describe the article.

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58. For an improvement in the *Double Acting Forcing Pump*; William Douglass, Middletown, Middlesex county, Connecticut, August 20.

It is here stated that the valves in the common double acting forcing pump are usually covered, and hinged with leather, and that the improvement which the patentee has made in this part, consists in the employment of puppet valves, of metal, which, he says, are well known, but not hitherto employed in such pumps. The cap, and bottom, which cover and sustain the main cylinder, and the suction and discharge cylinders, are to be so cast as to adapt them to the use of such valves. The claims made are, "*First*. The application of the aforesaid metallic *toad stool valves*, in the heads of my pump, in lieu of said leather valves, or any other kind of valves now in use in double acting forcing pumps. *Second*. The construction of the end pieces, or heads, of said pump, so as to cover at once the ends of the several cylinders, and so as to admit the insertion of metallic, or any other kind of valves, in said end pieces, or heads, instead of having them placed in the pipes."

Such valves have been used in double forcing pumps, as well as in others and we do not believe, therefore, that the claim of the patentee can be sustained; and if it can, he would certainly be confined to the particular arrangement which he has adopted.

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59. For *Slabs for Fire Backs, Stove Linings, &c.*; Joseph Putman, Salem, Essex county, Massachusetts, August 20.

All that we learn from this specification is, that moulds are to be made to receive the clay, which moulds must be in the form necessary to give to it the intended shape; that the clay is to be beaten in by a mallet, and the superfluous portion removed.

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60. For *Constructing Granaries*; John Harmony, Chambersburg, Franklin county, Pennsylvania, August 20.

The thing here patented is very simple, and, if effectual, is of great value. The "improvement consists in introducing a hog or sheep pen, either under or very close to a suitable room, or apartment, into which the grain is to be put, having found, by repeated experiment, that the effluvia of the pen, or some such cause, operates as a complete preventative against the attacks of the weevil, and also that, should the grain be infected by them, they will speedily leave it." After this information, the patentee describes what he esteems a good plan for the erection of such an establishment; but the particular mode is not considered as important, the claim being simply to "the combination of a hog pen, or sheep pen, with a granary, as set forth."

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61. For an improvement in the *Harrow and Cultivator*; Peter Clark, Aurora, Erie county, New York, August 20.

This cultivator is so constructed that its two sides, which form a V, as

usual, may be expanded, or contracted; there is also some variation in the manner of forming the teeth, but the change in this part does not appear to be very definite, or important. The claim is to "the peculiar formation of the tooth, without a flanch; the mode of fastening it, and giving it a forward direction suited to the graduated width of the harrow, and to the method of graduating the same."

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62. For an improvement in *Steam Boilers, and the method of feeding them*; Nathan Reed, Belfast, Waldo county, Maine, August 20.

The construction of this boiler, with its appendages, is very clearly described, and well represented in a good outline drawing; the things claimed, also, are distinctly set forth, leaving nothing to desire on this point.

The boiler is to be cylindrical, and is to contain within it a furnace, and a flue passing through it, in the manner of many others. The boiler is not to be placed horizontally, but is to be elevated at its back end; as shown in the drawing, this elevation is equal to one-half of its diameter. From the back end of the boiler there rises a vertical cylinder, which is to be the reservoir for steam, it being intended to keep the boiler entirely full of water, and to allow it to rise to a certain height also in the reservoir. The reservoir contains a float, which is to be sustained by the water, and from this float rises a vertical rod, passing through a stuffing box at the top of the reservoir. The apparatus by which the feeding of the boiler is to be regulated, is governed by a lever, acted upon by the rising and falling of the float rod; but the particular arrangement of the parts intended for that purpose, would require the drawing for its explanation. One peculiarity of this arrangement is, that the feeding of the boiler is to proceed when the motion of the engine is stopped; in this case, if the water is sufficiently low, a tube is opened, by the turning of a stop-cock, which admits a portion of steam from the reservoir into a case containing a small rotary engine, or steam wheel, constructed like an ordinary water wheel, which is blown round, and works the supply pump of the engine; when requisite, a portion of the steam blows off through another tube, opened at the same time with the former, as, otherwise, the velocity of the feeding engine might be too great.

The claims made are to the construction of the boiler, so that every part exposed to the action of the fire shall be kept constantly full of water, whilst the steam generated shall ascend freely into the reservoir, where it is isolated from the direct influence of the fire by a stratum of water. The manner of fixing and connecting the float, so as to ensure a more frequent action of the feeding apparatus. The method of giving vent to the accumulated steam, by the same operation which shuts off that from the engine; and the method of diminishing the velocity of the feeding engine, by the additional waste pipe.

Were it not the case that floats, rods sliding in stuffing boxes, supply pumps, and other apparatus usually combined and connected in self-regulating and self-feeding contrivances, added to steam engines and their boilers, are each liable to derangement from causes which cannot be rendered self-regulating, we should expect much from the apparatus described, which is ingeniously imagined, and looks well upon paper; but we are admonished, by some knowledge of practical results, not to trust implicitly to fair promises, and specious appearances, especially where complicated machinery, and powers of difficult management and control, are concerned.

63. For a *Brick Press*; Henry Hunsicker, and Joel Krauss, Northampton, Lehigh county, Pennsylvania, August 20.

This brick press possesses considerable originality, and is sufficiently well described. It contains two moulds, which are operated upon by the same lever, the moulds being upon a sort of railway, upon which they pass alternately under the lever. The moulds are of cast-iron, and their bottoms constitute movable pistons, which rise and deliver the brick at the top by the same movement which carries the moulds under the pressing lever. Each mould has its own follower, which rises, and closes on it, by the general shifting motion, all which is distinctly shown in the drawing. The claims made refer to the particular construction of the respective parts, for producing the action required.

64. For a *Washing Machine*; David Winthrop, Kennebec county, Maine, August 27.

Stocks, or beaters, are to be worked backward and forward in a trough, as in many other washing machines, the trifling change made in this we will not wait to describe, but merely give the claims, which are to "the application of the gear work to the stocks; and to the putting them directly through the arms of the stocks."

65. For a *Washing Machine*; William and John Collins, Norwich, New London county, Connecticut, August 27.

This machine is so much like that patented by Charles Otis, on the 15th of June last (see p. 62) that we need not repeat the description.

66. For the *Application of Hydraulic Cement to various purposes*; Obediah Parker, city of New York; Timothy Clowes, Hempsted, New York, and Lyman Garfield, Troy, New York, August 27.

American hydraulic cement is to be employed to form *lithotaphs*, for the bodies of the dead. An oblong mould of boards is to be made which may be seven feet long, and three feet wide; this is to be placed upon the ground, and a layer of about four inches of hydraulic cement put within it. The corpse, either in a coffin, or some suitable envelope, is to be laid upon this, and the mould, which should be about two feet six inches high, filled with the cement, the mould being then removed, the *lithotaph* is finished.

Rows of these may be placed close to each other, and upon them may be deposited other *lithotaphs*, so as to form a *necropolis*.

This forming of *lithotaphs*, and a *necropolis*, is claimed by the patentees; and also the forming of lithotaphs in ordinary vaults, or repositories of the dead. They also claim the giving to them different forms, with inscriptions, &c.

We have so often given our opinion respecting this kind of application of what is well known, in a way obvious to every one, that we shall not repeat it here. We are, in this instance, at no little loss how to assign to each of these patentees a share in inventing a thing which has no, or very little, invention in it, yet each must have contributed his quota, and we take it for granted that each can point to his own share. (See Dayton, Hoyt, and White's patent, p. 39, and White's, No. 35, for July.)

67. For *Ranges for Cooking, &c.*; Thomas B. Smith, city of New York, August 27.

A series of cast-iron boxes, lined in part with fine brick, is placed within a table, or dresser, for cooking, &c; each of them is to have a grate to sustain the coals, and an ash-pan or drawer, below it; provision is made for varying the height of the grates, by placing them upon different ledges, and there is to be a flue to carry off the heated air, &c."

*Claim.*—"What I claim as my own invention in the foregoing range, is the combination of the whole; and its application to use in the manner described."

In a contrivance so old as ranges of such boxes for stewing, boiling, &c., &c., so very like those described, it is to be wished that the patentee had been less general in his claim, and that he had distinguished his invention "from all other things before known or used."

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68. For *Arresting the Sparks from Locomotive Engines*; Alfred C. Jones, Portsmouth, Norfolk county, Virginia, August 27. (See description at p. 100.)

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69. For improvements in the *process and Apparatus for Distilling Spirits of Turpentine*; Isaiah Jennings, city of New York, August 27. (See Specification.)

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70. For an *improvement in the art of manufacturing Neck Stocks*; Thomas Goodrum, city of New York, August 27.

"The principle of this improvement consists in the manufacture of neck stocks with strips or pieces of whalebone, of any convenient size and shape, instead of bristles or hair."

The whalebone is to be split into fine shreds, and interwoven in the foundation for stocks, as hair is interwoven. The patentee tells us that "the advantage of this material, over other materials, consists in its cheapness, and in its preserving, in a superior degree, its elasticity, in not being liable to be broken down, and in its uniformity of size, being of the same size throughout, whereas bristles and hair are tapering, and larger at one end than at the other."

The validity of the patent does not depend upon the validity of each of the reasons assigned for its superiority, or we should really doubt its being sustainable.

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71. For an *improvement in the Gearing of Mills*; Cleaverious R. Coleman, Barry's Bridge, Lunenburg county, Virginia, August 27.

A complex arrangement of wheels is here described, which presents nothing new in principle, or advantageous in practice, although the patentee proposes its application to mills of nearly all kinds. Thirteen cog wheels are represented in the drawings as employed to get up the intended motion. There are two wheels, or rims, with teeth on their interior, pointing towards the centre: these are fixed to a frame, one above the other, the main shaft, with four cog wheels on it, revolving vertically within them; two of these cog wheels mash into two others, which in their turn mash into the rims, within which they travel round.

We do not think it necessary to trace the movement any further, but will add the fashionable claim of the arrangement and adaptation of the several parts of the before described machinery for the gearing of water, wind, horse, hand, steam, saw, cotton, thrashing, and fanning mills."

72. For a *Thrashing Machine, for Rice and other grain*; William Matthews, Charleston, South Carolina, August 27.

Most of the parts of this thrashing machine are so similar to many others before used, that it would be time lost to describe them: in making out his claim, the patentee seems to be at some loss to divide the new from the old, as will appear from the following.

"What I claim as my invention is, *first*, the plan of setting the forward feeding table roller nearer to or further from the feeding rollers. *Second*. The application of the cog wheel gearing, according to the plan and proportions set forth, for driving the feeding rollers. *Third*. The application of a beating cylinder, either with stationary bars, and square, or rather oblong teeth, (or with the hinge beaters, though I do not claim the invention thereof) to a concave bed as described above; though I do not claim said form of bed as my invention. *Fourth*. The application of the comb, driven as above set forth, and over the bed above described; though I do not claim the invention of said combs or bed."

The foregoing may serve well to exemplify the absurdity of the claim so frequently made to the *application* of what belongs either to an individual, or to the public. It is the application of what a patentee himself invents, that gives to his patent its whole value.

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73. For a *Thrashing Machine*; John Gearhart, Rush township, Northumberland county, Pennsylvania, August 27.

"What I claim as my invention, or improvement, in the machine for thrashing grain and seed, is the mode of constructing the concave beds and cylinders as above set forth. The concave bed differs from those of other thrashing machines by being *whole*, instead of being segments, and of course is more solid and true, and can be put in, or taken out of, the frame, with much greater facility. The cylinder differs from those of other thrashing machines by being *whole*, instead of being in *segments*, and of course is more solid and true."

If the patentee had seen one half of the thrashing machines which have been devised and made, the above supposed difference would have vanished from his imagination.

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74. For a *Plough*; William Holt, Buffalo, Erie county, New York, August 27.

The mould board, share, and coulter, of the cast-iron plough, are, according to his statement, improved by the patentee; but if they are so, he has failed in pointing out his improvements with sufficient clearness. We are told that the handles and beam are to be of wood, but that the mould board must be of cast-iron, as also must the land side and the share; the latter is to have a square point for the purpose of entering the lower part of the coulter. Several other equally important matters, of a like nature, are stated, to which is added that the plough is to be "used by applying horse power to the end of the beam, and is guided by a person having hold of the handles." The specification closes with the information that his plough will perform its work in a very superior manner."

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75. For *Fire Engines*; Thomas Odiorn, Portsmouth, Rockingham county, New Hampshire, August 27.

In this fire engine the box that is to contain the water is covered with a circular platform upon which the persons who work it are to walk; the engine being worked exactly in the manner of a ship's capstan. The head into which the levers are inserted revolves upon a hollow shaft through which the tube ascends that leads to the crane neck. There are teeth on the lower edge of this head, forming it into a crown-wheel, and these take into four pinions, having cranks on them, which work the pistons of four pumps, forcing the water into a central air vessel. The claims made embrace the particular mode of constructing and working fire engines, as above described.

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76. For a *Pump applicable to Ships and other purposes*; Thomas Odiorn, Portsmouth, Rockingham county, New Hampshire, August 27.

There are to be two pumps, placed near to each other, and above these is a shaft placed horizontally, with a winch at each end, by which it is made to revolve. The pumps used are the "triangular valve pumps" invented and patented by Jacob Perkins, and described and represented in Rees' Cyclopaedia. A strap, or chain, is attached to the rising valve of each of these pumps, and raises it by winding round a drum on the horizontal shaft; these drums are alternately thrown in and out of gear, so that whilst the bucket of one pump is being raised, the other descends by its gravity, and in this way a constant stream is obtained from one or the other of the pumps. The claims made are to the particular form and arrangement of the respective parts, described and figured, by which the drums are thrown in and out of gear, and the pumps alternately worked.

The description and plate of Mr. Perkin's pump will be found under the article *Pneumatics*, in Rees, and the mode of working it there shown will be found incomparably superior to that now patented, the power being more readily and advantageously applied.

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77. For a *Grater*; Ebenezer B. Story, Buffalo, Erie county, New York, August 27.

This grater consists of a sheet of tin perforated with holes, and placed in a box in a sloping direction, so as to make an angle of fourteen degrees with the horizon. "The length of the box on the top is to be two feet one and one fourth inch. The length of the bottom of said box is one foot eight and one fourth inch; the width ten inches, the height thereof nine inches. The size of the grater may be varied to suit the wishes of the person for whose use it is made. I claim therefore the invention of such grater, and such improvements as herein set forth and described."

A more trifling patent than this does not often find its way to the office.

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78. For *Roller Grooving Planes*; James Herman, Lancaster, Fairfield county, Ohio, August 27.

This improvement consists in placing metallic rollers on the face, and on the fences of the planes to lessen the friction; an additional bit is also to be added to each plane, for the purpose of champhering the corners of the tongue and groove. We are not sure that the rollers will be deemed an improvement by workmen generally, a certain adhesion of the plane to the stuff being generally thought advantageous. Much care also will be required, or the gudgeons of the rollers will soon wear out. Would not steel facings be better?

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—There are no occultations of stars of the sixth magnitude, and upwards, visible at Philadelphia in the month of April.

S. C. WALKER.

*Meteorological Observations for December, 1835.*

Moon. Days.	Therm. Sun 2 P.M.	Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Direction.	Force.		
1	29	35	29.90	W.	Moderate.		Clear—lightly cloudy.
2	31	27	30.10	NW.	Bustring.		Clear day.
3	12	27	30.20	W.	Calm.		Clear—lightly cloudy.
4	24	30	29.76	SW.	Moderate.		Clear—lightly cloudy.
5	31	33	29.60	W.	Bustring.		Clear—flying clouds.
6	20	32	29.60	NW.	Moderate.		Lightly cloudy.
7	20	30	29.80	W.	Brisk.		Clear—lightly cloudy.
8	24	28	29.94	W.	do.		Cloudy—clear.
9	24	40	30.00	SW.	Moderate.		Clear—lightly cloudy.
10	30	31	29.95	W.	Bustring.		Clear day.
11	15	33	30.00	W.	Moderate.		Clear—lightly cloudy—snow in night.
12	31	34	29.94	N.	Brisk.	1.05	Rainy day.
13	32	32	29.80	W.	Moderate.		Lightly cloudy.
14	28	43	29.60	SW.	Brisk.		Clear—lightly cloudy.
15	19	36	29.85	SW.	Moderate.		Clear day.
16	8	13	29.95	W.	Bustring.		Clear—lightly cloudy.
17	5	11	30.22	W.	Moderate.		Lightly cloudy—sleet.
18	15	25	30.21	SE.	do.	.37	Street—cloudy.
19	26	26	30.06	E.	Calm.		Thaw—foggy.
20	32	34	29.10	SE.	do.	.13	Rain—cloudy.
21	31	41	29.90	W.	do.		Cloudy—clear.
22	32	33	30.15	W.	Moderate.		Clear day.
23	17	25	30.15	SW.	do.		Clear—lightly cloudy.
24	17	30	29.90	SW.	Calm.		Cloudy—lightly cloudy.
25	35	45	29.90	S.	do.	1.25	Rain—cloudy.
26	44	47	29.45	NW.	Bustring.		Flying clouds.
27	36	35	29.50	SW.	Moderate.		Clear—flying clouds.
28	22	39	29.65	NW.	do.		Lightly cloudy.
29	26	39	29.75	NNE.	do.		Clear—lightly cloudy.
30	30	42	29.60	NW.	do.		Cloudy—clear.
31	33	32	29.62	NW.	do.		
Mean	24.74	32.77	29.87			2.80	

Thermometer.  
Maximum height during the month, 47, on 26th.  
Minimum do. 5, on 17th.  
Mean do. 28.75

Barometer.  
30.40 on 3d.  
29.45 on 26th.  
29.88

NOTE.—The specifications of American patents, and several original articles, intended for this number, have been forced out, and are unavoidably postponed to the next month.

**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
Of the State of Pennsylvania,  
AND  
**MECHANICS REGISTER;**  
DEVOTED TO  
**Mechanical & Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

APRIL, 1836.

**Practical and Theoretical Mechanics.**

*Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.*

*(Continued from page 164.)*

*VII. To determine by actual experiment whether any permanently elastic fluids are produced within a boiler, when the metal becomes intensely heated.*

To make this experiment, the bottom of the boiler was to be intensely heated, water to be injected, and the elastic fluids disengaged, to be collected. The bottom of the boiler being cleaned, heated water was thrown in from the forcing pump, the elastic fluids produced flowed through a flexible tin pipe which was attached to the stop cock *a*, (Plates 1 and 2,) and passed into a tub containing water. At the end which dipped into the water, there was a stop-cock, opening and closing the pipe at pleasure; the cock *a*, was always open. On the first day's trial, a small quantity of water, previously placed in the boiler, was allowed to boil away; the bottom of the boiler was heated to redness, and water injected. The stop-cock being opened under a receiver, in the tub serving as a pneumatic cistern, a gas which issued through the flexible tube was collected, the water condensing the high steam with which the gas was mixed. The smell of this gas was empyreumatic, an opaque white vapour came over with it, which disappeared on standing. Half a pint of the gas was collected for examination. The injection of water being continued, the gas ceased to come over.

This gas was subsequently examined; it was a non-supporter of combustion,  
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was not combustible, did not render lime water turbid; it was, in short, nitrogen gas, with perhaps a small admixture of oxygen.

These observations were considered as only preliminary to a more extended examination of the subject. The theory which makes the decomposition of water, by heated metal, produce hydrogen, and this gas by its union with oxygen, produce explosion, has been supported by many, and deserved a respectful examination. The difficulty of finding the oxygen for the hydrogen to recombine with, has been ingeniously, though, as we conceive, not successfully, parried. The fact, that though water is decomposed by heated iron, hydrogen gas decomposes heated oxide of iron, has also been plausibly urged and supported by collateral evidence, of a similar nature, drawn from the action of heated copper upon ammonia.

To study the subject in detail, it was necessary to examine the relative effects of hot and cold water; the relation between the quantity of gas produced, and of water injected, at different temperatures of the bottom of the boiler; and to raise the temperature of the metal so high that no objection on that score should exist to the results. Moreover, the oxidated surface was to be removed, and the boiler exposed to the action of the water in as clean a state as the nature of the case admitted. The gas was collected in graduated jars, the water drawn in by the forcing pump was taken from a measure, and the quantities injected noted. The time was also noted between the experiments.

The conclusions to which the committee were brought, render a detailed exhibition of the experiments unnecessary, except so far as such a statement may go to show the degree of care which was used in prosecuting the subject, and thus to give confidence in the results. The experiments of the *first* day in which the gas was collected as already described, were tentative, they served to render the methods of experimenting more precise.

On the *second* day, one of the glass plates in the boiler-head cracked, and the escape of gas with the steam, through the crack, rendered the results as to quantity, inconclusive. The gas was uniformly found to extinguish a candle, and not to burn itself. The mercury in the iron tube into which the thermometer N, Plate 1, dipped, soon boiled; the thermometer had been previously removed. The thermometer in the other tube M, was observed as giving an indication of whether the temperature within was increasing or diminishing.

It was now distinctly seen that the air which furnished the nitrogen gas, before referred to as issuing from the boiler, was not derived from the water injected. The injection of one fluid ounce and a quarter troy (2.25 cubic inches) of water, never gave less than 2.6 cubic inches of gas, and sometimes notwithstanding the leakage, gave 17.28 cubic inches. But water absorbs, according to Saussure, from 5 to  $5\frac{1}{4}$  per cent. of its bulk of atmospheric air, giving for 2.25 cubic inches only .118 of a cubic inch of air, not one-twentieth part of the minimum quantity of gas derived from the boiler by the injection of 2.25 cubic inches of water. On observing closely the cracked glass plate, it was seen, that after a certain period in the production of steam by the water thrown into the boiler, the vapour ceased to issue through the crack, and finally, that a bending inwards of the pieces of glass indicated that the pressure within the boiler was less than that without, and that atmospheric air had access to the interior. As no inflammable gas had as yet been obtained, and as the gas which issued was nitrogen mixed with oxygen, the entrance of air into the boiler was obviously the source of the gas collected.

A new glass plate was substituted, on the *third* day, for the broken one, and a copper plate was screwed upon the opposite opening of the boiler, which

was thus rendered as tight as the nature of the apparatus permitted. The experiments were made at regular intervals, varying in different parts of the series from sixty to ten seconds, and in such a manner, that the bottom of the boiler might be found in nearly the same state, in some of the experiments, with each interval. The interval was counted from the time at which gas ceased to issue in a previous experiment, to the instant of injecting water. The unit of measure of the gas was 1.8 cubic inches. The results were as follows.

Fluid ounces of water injected.	Interval in seconds.	Measures of gas collected.	Ounces of water injected.	Interval in seconds.	Measures of gas collected.	Ounces of water injected.	Interval in seconds.	Measures of gas collected.
$\frac{1}{2}$	60	10†*	$\frac{1}{2}$	30	5	$\frac{1}{2}$	10	4
"	30	10†	"	"	9	"	60	10 $\frac{3}{4}$
"	"	10 $\frac{3}{4}$	"	"	8	"	10	6
"	"	10 $\frac{3}{4}$ †	"	10	6	"	60	7
"	20	10	"	"	5	$\frac{3}{4}$	10	5
"	"	8	"	30	10 $\frac{3}{4}$ †	$\frac{3}{4}$	10	4
"	"	6	"	10	10			
"	10	6	"	"	7			
"	"	7	"	"	5			
"	30	5	"	60	6			
"	"	9	"	"	10			
"	"	8	"	20	6			
"	10	6	"	10	4			
"	"	5	"	60	7			

\* The numbers marked (†) signify that an unmeasured portion of the gas escaped

In this series we remark, first, that the mean result for an interval of 60 seconds, is 8.5 measures; for an interval of 30 seconds, 9.1 measures; for 20 seconds, 7.5 measures, and for 10 seconds, 6.9 measures.

If atmospheric air leak into the boiler, the air will enter until the pressure within and without become equal. Hence an increase in the interval between two experiments in which the air should be expelled, would, above a certain point, be attended with no increase in the quantity of gas which would be expelled; the only effect being to consume, more completely, the oxygen of the entering air. Up to this point an increase of interval should be attended by an increase of air which would leak in, and consequently by an increase in the amount subsequently expelled. The mean results given above do, in fact, show an increase in the quantity of gas obtained after an interval of 20 seconds, over that obtained for 10 seconds: of 30 seconds over 20 seconds. They give a slight decrease from the interval of 30 seconds to 60 seconds, which will find its explanation on a further examination of the results.

Second; we observe from the table, that after a number of short intervals, the succeeding long interval never gave as much gas as when the long interval had been repeated; and, vice versa, that after a series of long intervals, the next succeeding short interval gave a higher result than that which followed. The experiments, with an interval of 30 seconds, were not as much interspersed among the short intervals, in the last part of the series, as were those of sixty seconds; the mean of the results for this latter interval is therefore diminished.

No increase in the amount of gas was obtained by increasing the quantity of water injected. The mean of four experiments, when the bottom was at a glowing red heat, and the thermometer seven and three-quarter inches from the bottom, at from  $553^{\circ}$  to  $559^{\circ}$  Fah., was 5.75 measures for  $1\frac{1}{2}$  ounces of water; from  $572^{\circ}$  to  $580^{\circ}$ , by the same thermometer, 10.5 measures for the same quantity of water injected; above the range of the scale of the same thermometer, 12 measures for  $1\frac{1}{2}$  ounces, and about the same quantity for 2 ounces. During these experiments, mercury, which was on the top of the boiler, in a clay receptacle, boiled freely. The best evidence is thus given that the bottom of the boiler was not wanting in heat; it was, in fact, at a bright red heat during the last part of the experiments.

The peculiar odour, before remarked, as belonging to the gas expelled from the boiler, still continued, indicating the presence of sediment within the boiler; this could be seen when the metal was glowing. A scale of oxide also appeared on the bottom, which now and then cracked, presenting irregular luminous lines as the boundaries of the scale.

The experiments just detailed were, on a succeeding day, repeated, to ascertain whether the same results would be reproduced. The bottom of the boiler being at a bright red heat, an interval of 60 seconds gave, as the mean of four experiments, 11.5 measures of gas for one ounce of water injected; an interval of 30 seconds gave, as the mean of five experiments with three-fourths of an ounce of water, 13 measures; an interval of 20 seconds gave, as the mean of four experiments with half an ounce of water, 10.6 measures: and again, in a second series, the same interval gave 10.5 measures for the mean of four experiments with five-eighths of an ounce of water. Towards the close, the numbers for 10 seconds of interval were very variable, the mean of six experiments with .65 ounces of water, injected when the boiler was at a cherry red, was 6.3 measures of gas; with a heat which, to all appearance, was the same, the gas collected diminished to 3.5 measures, and averaged  $3\frac{3}{4}$  measures at a bright red heat. For an interval of 5 seconds, with  $1\frac{3}{4}$  ounces of water injected,  $4\frac{1}{2}$  measures of gas were obtained. The conclusions to be drawn from these results agree with those already deduced from the previous experiments, which were thus confirmed. The gas collected was carefully transferred, over water, to the laboratories, where it was analysed. One specimen yielded Professor Hare, nitrogen with seven per cent. of oxygen; another, examined by Professor A. D. Bache, gave nitrogen, and  $9\frac{1}{2}$  per cent. of oxygen: in each case the results were obtained by exploding a mixture of the gas with hydrogen.

The boiler was now thoroughly cleansed, that the scale of oxide upon the bottom might be removed; in doing this, the hand-hole was necessarily removed, and had to be repacked. Paper was placed between the glass plate at the back end of the boiler and its metallic covering, that the boiler might be tightened. To ascertain the amount and direction of the current setting into, or out of, the boiler at any time, a copper pipe, terminating in a glass tube, was attached to one of the stop-cocks on the head, at the fire end of the boiler, the glass tube dipping into a vessel containing water.

The injection water was, on resuming the experiments, heated over a small furnace, to boiling, in a metallic vessel, from which it was drawn by the pump. When the bottom of the boiler was at a bright red heat, the lowest thermometer had attained a temperature of  $570^{\circ}$ , and was soon after removed. The quantity of water thrown in at each stroke of the pump, was now by no means so regular as when the action of the pump was not impeded by the formation of steam within it, from the injection water. The results obtained were:—

No. of strokes of pump.	No. of measures of gas collected.	REMARKS.
2	2	Injection water hot.
„	$\frac{1}{2}$	Redness not visibly diminished by water injected.
2	$3\frac{1}{4}$	Bright red. Experiments made after a rest. Gas puts out candle.
2	$3\frac{3}{4}$	Bright red. Do.
2	$1\frac{1}{2}$	Do. Do.
6	3	Do. Gas burned at mouth of jar with a blue flame.
1	$\frac{3}{4}$	
1	$\frac{1}{2}$	Gas burns with blue flame.

A combustible gas had appeared for the first time. The injection water was now changed for cold water, and a gas obtained, which burned as before; 11 measures of air and one measure of the gas detonated slightly, also one to  $8\frac{1}{2}$  measures of air; neither detonation was sufficiently violent to extinguish the candle held at the mouth of the jar in which the gases were fired.

The gas now came over, not in copious bubbles and during a short time, but slowly and continuously, as if resulting from a constant, but not violent, chemical action. After these results had been obtained, the violent and brief bubbling, when the water was injected, recommenced, and the combustible gas was no more obtained. The change of hot injecting water for cold, and the collection of the combustible gas after the change, showed that the gas was not derived from any effect produced by the increased temperature of the liquid introduced. The other circumstances which had been different from those of former experiments, were the superior cleanliness of the bottom of the boiler, and the repacking of the hand hole with cloth, oil and putty, and of the glass window with paper. Before proceeding to the detail of the experiments, in examination of the source of the combustible gas obtained, it may be well to mention that the glass tube, already spoken of, showed, after the water injected in some of the experiments had evaporated, a current of air, due to a force equivalent to a head of from  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches of water, from the exterior into the boiler; in one experiment it is noted that the water, in the tube referred to, soon fell, which indicated a leak in some part of the boiler.

On the day following that upon which the experiments just given, were made, nothing conclusive was obtained; no combustible gas appeared, but the heat was hardly as high as on the preceding day. Small disks of wood, thrown into the boiler, gave a combustible gas, which came over just as was noticed in relation to the inflammable gas of the preceding day's experiments. That these inflammable gases, in mixture with the oxygen, remaining in the atmospheric air, within the boiler, produced no explosion, is in accordance with

the well known fact in relation to them; pure hydrogen, in such a mixture, combines with oxygen under the influence of a body heated to redness.

On the following day of experiment, circumstances proved entirely favourable; the bottom of the boiler was heated as intensely as on the former occasion. After much incombustible gas had been obtained, traces of an inflammable one appeared. A strong smell of oil was noticed about the hand hole, at the back end of the boiler; the packings were now white on the exterior. The fire was urged, and the boiler became strongly heated throughout its whole length. The following results are from the journal of the experiments.

Each stroke of the pump threw in 5-8ths of an oz. of water. The gas is that collected by one stroke of the pump.	Appearance of Boiler.	No. of Measures of Gas.	REMARKS.
	Bottom bright red,	16	Candle burns feebly in gas.
	do.	10½	A piece of paper put against back hand hole is charred.
	Very bright,	14	Wood put at back end of boiler (outside) charred. Paper browns on top. Gas puts out candle.
	do.	7	Gas puts out candle.
	Heat same (about) as first day of finding inflammable gas,	} 8	
	do.		
	do.	7½	Wood chars at fire end (outside) being the less heated end.
	Heat greater,	5	
	do.		Gas extinguishes candle and does not burn.
	do.		No smell of oil gas. Wood at both ends charring. Paper on top of boiler charring.

No combustible gas was procured in these experiments, though the circumstances were more favourable to the production of hydrogen, by the boiler, than on other occasions. On examining the cloth packing of the hand holes at each end, it was found to have disappeared, except in spots; the putty was white. The boiler was not dirty enough to colour, with oxide of iron, clean water which was introduced.

These results point conclusively to the packing, as the source of the combustible gas obtained. The flame of that gas was that of carburetted hydrogen, and not of pure hydrogen. They further show that even in this intensely heated state of the bottom of the boiler no hydrogen was liberated by the decomposition of the water injected.

In conclusion, it appears from these experiments:

1. That the gas obtained by injecting water upon the bottom of a boiler which was at a bright red heat, was nitrogen gas, with a variable quantity of oxygen: it was, in fact, atmospheric air deprived, by the heated metal, of more or less of its oxygen.

2. That this air was derived, principally, from the current into the boiler when surcharged steam had ceased to be formed, and the boiler was left dry; there will, therefore, be no such quantity in a working boiler, where the air must be supplied from the cold water thrown in.

3. That water in contact with heated iron in a steam boiler, the surface being in its ordinary state, clean, but not bright, is not decomposed by the metal.

*VIII. To observe accurately the sort of bursting produced by a gradual increase of pressure within Cylinders of Iron and Copper.*

It has been contended by some, that ruptures produced by a gradual increase of pressure within steam boilers do not bear the character of explosions, but that a mere rending takes place, giving escape to the contents. This has been assumed to be especially the case with copper boilers. To make the observation required by the above question, cylinders of iron and copper were prepared, of sufficient size, to make a small thickness of material answer for rending by a pressure which was easily attainable. Two experiments made, one with an iron and another with a copper cylinder, afforded so direct an answer to the query that it was not deemed necessary to carry the experiments further, especially as they were tedious, and not without danger. A further experiment of the same tenor, resulted from a trial of Perkins's assertion in regard to the effect of making an opening in a vessel containing water, and heated to a high temperature.

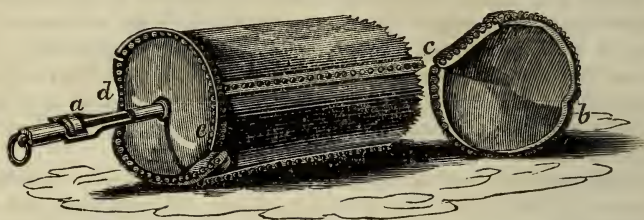
The boilers used were cylindrical, eight and a half inches in diameter, and ten and twelve inches respectively in length, of iron .02 inch thick, and of copper .03 inch thick, having iron heads .05 inch thick, to which the convex surface was fixed by iron rivets, placed nearly touching each other. A single opening in the middle of one of the heads of each boiler was provided to introduce the water, and was furnished with a screw, into which to insert a tube and piston, connected with a small spring weighing machine, which is represented at *a* in the cut on page 224. Upon the cylinder of this machine a ring was placed, which was moveable along the cylinder by a slight pressure: this ring was forced towards the end of the cylinder nearest to the boiler head, as the spring was bent and remaining in its place when the spring relaxed, served to register the maximum pressure to which the piston had been exposed previous to observing it.

The iron boiler was placed in a heavy cylinder of wrought iron, which served as a furnace, the axis of the boiler being nearly horizontal, and that of the furnace cylinder vertical. The boiler, having been half filled with water, was placed upon a fire of charcoal, and when the water boiled, the register machine for the pressure was screwed in.

The place selected for the experiments was in a deserted quarry on the banks of the Pennypack, near Holmesburgh. The high bank served as a protection, by the aid of which the experiments were viewed with little danger. A wire and cord were attached to the head of the boiler, to draw it from the fire when the latter required to be replenished. A leak in the riveting of the iron boiler allowed so much steam to escape that the boiler did not give way on the first trial. As soon as the escape of steam was observed to cease, the boiler was removed from the fire and again half filled with water. The fire was urged, and the boiler settled lower into it, and by once replenishing the fuel, without removing the boiler, an explosion was produced. Part of the committee were engaged in observing the progress of the experiment at this moment. The fire was near the middle line of the boiler, burning not strongly near that line, but very rapidly below the boiler; the steam issued freely through the leak before alluded to, and the whistling sound which it produced, and which had increased gradually in strength as the experiment progressed, seemed constant. The length of time during which the steam had escaped showed the water to be low, and induced the supposition that a second time the object would fail; when an explosion occurred. The explosion tore off one of the heads, *b c*, of the cylinder, projecting the other parts of the boiler in an opposite direction, carrying with them for a portion of the distance, the iron cy-

linder forming the furnace, and scattering the fuel in every direction. The report attending the explosion resembled that from a small mortar (eprouvette) fully charged, the steam mixed with the smoke was not considerable in quantity, and few marks of water were to be seen. The boiler head was thrown fifteen feet, the boiler and spring register about six feet, and the furnace, weighing about forty-five pounds, was overturned and carried four feet. The pressure indicated by the register was eleven and a quarter atmospheres.

In examining the boiler it appeared that the head, *b*, which was thrown off,



had first struck against the iron furnace, which had deflected it outwards; this is shown by the indentation, *b c*, in the figure. This head was forced off all around in the line of rivets which attached the head to the boiler, the metal remaining between the rivets being less than the space occupied by them. The convex surface and the other head were thrown likewise against the furnace, and the head indented at *d e*, overturning the furnace and carrying it four feet, as already stated. The boiler finally struck against the side of the bank of earth. The piston of the weighing machine was somewhat bent in the experiment.

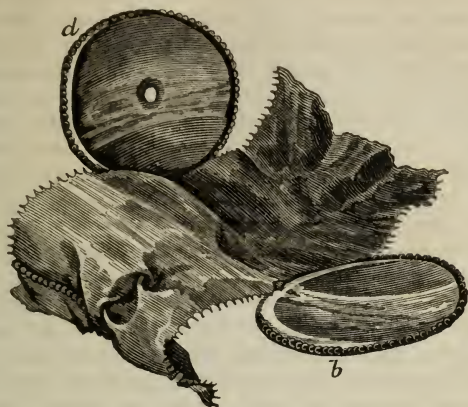
The circumstances of this experiment show that the steam rose quite gradually on account of leaks in the boiler, increasing, probably, more rapidly as the quantity of water diminished, the intensity of the fire meanwhile increasing. That at a certain period the tension within had attained about eleven atmospheres, when the boiler *exploded violently*.

The accompanying figure will serve to give an accurate idea of the appearance of this boiler after its rupture.

The cylinder of copper, before referred to, was next put in the place of the iron boiler, and the fire again kindled; the general arrangements being as before described. This boiler being longer than the former would not descend so far into the furnace, and an attempt to raise the steam sufficiently high to burst it failed: there was a considerable leak in the junction of the curved surface with one of the ends. When the water was nearly exhausted, the fire having passed its period of greatest heat, the cylinder was removed and water again introduced, filling about three-fourths of its capacity. A new furnace was constructed of stones, allowing the boiler to rest more closely upon the fuel and affording a screen from the wind which was blowing quite strongly. The part of the boiler in which the leak had been observed was turned downwards, but a similar escape was found for the steam in the part now uppermost. The tension of the steam appeared to increase very slowly, and the fire passed its best action without effect; it was renewed, and as the water became lower the tension of the steam increased considerably. As before, nothing remarkable occurred previous to the instant of explosion, and the members of the committee, employed in the experiments, were engaged in observing the boiler at the instant it exploded. A dense cloud of smoke and flame, capped by steam, rose from the pit; the stones and combustibles were

widely scattered, and the boiler was thrown, in a single mass, about fifteen feet from the furnace. The noise attending this explosion was like that from the firing of an eight inch mortar.

The boiler was rent as shown in the accompanying figure, giving way in



an irregular line just above the probable water line on one side of the boiler, but not conforming to it. *d* and *b* were the lowest points in the two heads before the explosion. The sheet of copper was torn from the heads, unrolled and irregularly bent, adhering to the heads for only a short distance near the top of each; and the heads were bent outwards. The thickness of the copper along the line of rupture varies from .025 to .035 of an inch, and the metal appears to have been highly heated at one end of the torn portion. The piston of the spring gauge was bent, the screw which attached it to the boiler broken, and the whole instrument otherwise injured; it appeared that the wire intended to draw the boiler off the furnace had slipped and impeded the action of the piston, so that no register of the amount of force producing this explosion was obtained.\*

The circumstances, as before, show that the steam was allowed to rise gradually until the boiler gave way. It is possible that there may be a relation between the space occupied by the water and that in which the steam is formed most favourable to the production of steam, and that when this was attained a rapid rise in elasticity took place; but there were no circumstances observed which would confirm such a view, and if it were correct it would only affect the conclusion as far as the increase of tension might have been rapid from such a cause.

As in the former case the marks of the sediments remained in the boiler, and indicated that the water was about an inch deep when the cylinder exploded. Much more steam was formed, and more water left than in the first experiment.

These experiments, together with the one referred to in a subsequent part of this report, are direct and conclusive; they show that *all the circumstances attending the most violent explosions may occur without a sudden increase of pressure within a boiler.* There can be no doubt, however, that if particular

\* Assuming the strength of copper at 36,000 lbs. to the square inch, and that it was uninjured by the heating, neglecting also the effect of temperature, the bursting pressure appears by calculation, to have been about sixteen atmospheres. It was, no doubt, less than this.

portions of a boiler are much weaker than other parts, they may give way in time to prevent such a catastrophe.

*IX. To repeat Perkins's experiments, and ascertain whether the repulsion stated by him to exist between the particles of intensely heated iron and water be general; and to measure, if possible, the extent of this repulsion, with a view to determine the influence which it may have on safety valves.*

The first trials upon this subject were made under atmospheric pressure. An iron bowl, about  $\frac{1}{16}$ th of an inch thick, and having the bottom perforated with small holes, was heated to redness over a charcoal fire, and water poured into it; the mass of metal being small, was cooled down very rapidly to a temperature below redness, and the repulsion which was at first manifested between the water and iron ceased, and the water flowed rapidly through the apertures. Two thicker bowls were provided, one of wrought iron,  $\frac{3}{8}$ ths of an inch thick, and the other of cast iron, seven-sixteenths of an inch thick; the bottom of each was perforated with holes, about .04 of an inch in diameter. When placed over a charcoal fire and heated to redness, water poured in so as to fill the bowls, reduced the temperature of the wrought iron one most rapidly, but until the reduction was effected, the results were the same as those for the cast iron bowl. In this latter the water rested upon the bottom without passing through the holes, either as water or as steam; steam formed slowly and escaped from the upper surface, the whole fluid being at a temperature below the boiling point. The openings were distinctly to be seen, and appeared by measurement to have contracted about  $\frac{1}{4}$ th part of their diameter; but the repulsion was such as to render the escape of the water quite as difficult, and indeed more difficult, than that of mercury at ordinary temperatures. Removing the vessel from the fire, the water remaining in it, as the material cooled below redness, small particles of water came through at intervals; at a lower temperature large drops collected, which finally united into a full stream. Some rude measurements of the quantity of water which came through when the iron was heated in water at different temperatures, showed a striking diminution at the higher temperatures. These results were obviously not produced by the closing of the apertures as the bowl expanded by heat, the openings being distinctly visible at a red heat.

The measurements referred to above were as follows: at  $58^{\circ}$ ,  $3\frac{5}{8}$  fluid ounces of water passed through the holes, in the cast iron bowl above referred to, in thirty seconds; the whole quantity of water added, being four ounces.

In another experiment at  $60^{\circ}$ ,  $3\frac{3}{4}$  fluid ounces passed. Water at between  $58^{\circ}$  and  $60^{\circ}$  being thrown into a bowl previously heated to  $82^{\circ}$ ,  $3\frac{1}{4}$  fluid oz. passed through; when heated to  $170^{\circ}$ ,  $2\frac{7}{8}$  oz. passed in the same time, and when heated to  $660^{\circ}$  about  $2\frac{1}{16}$  oz.

In another series, the same bowl being heated to redness, four fluid ounces of water thrown in were perfectly repelled for 15 seconds, and at the end of half a minute only  $\frac{3}{8}$ ths of an ounce had flowed through the openings.

Of a second quantity of four ounces thrown into the bowl thus cooled,  $1\frac{5}{8}$  oz. passed in 30 seconds, next  $2\frac{1}{4}$  oz. in the same time.

These experiments show that the amount of the force of repulsion between water and heated metal, is measurable even at moderate temperatures, and rapidly increases with the increase of temperature of the metal; the temperature of the water being in each case, of the last set of experiments, nearly the same. They confirm, in this respect, the results of the vaporization of water by metal at different temperatures.

The pressure of the column of water which was supported over the lowest

of these openings at a temperature between  $660^{\circ}$  and a red heat, or  $800^{\circ}$ , was less than one inch and a half of water.

The committee now proceed to give an account of an unsuccessful attempt to repeat Perkins's experiment referred to in the query. As it does not seem to bear upon the application of the safety-valve, they did not deem it necessary to encounter the expense of the apparatus necessary to a further trial.

The experiment of Perkins, which is more particularly referred to in the query, is that in which an opening having been made in one of his generators, containing intensely heated water in contact with red hot metal, neither steam nor water escaped, and in which having affixed a pipe and stop-cock to the same vessel, no steam issued through the cock when opened. To repeat this with a view to ascertain, as required in the query, the size of opening to which such a result would apply, three apertures were made,  $\frac{1}{16}$ th,  $\frac{1}{8}$ th, and  $\frac{1}{4}$ th of an inch respectively, in the sides of a wrought iron mercury-bottle; these were closed by conical plugs connected with levers, by which the plugs could be withdrawn from the sides of the bottle. The fulcrums of these levers were attached to the wrought iron cylinder already referred to, within which, its axis coinciding with that of the cylinder, the cylindric bottle was placed. An earthen-ware furnace was placed below the bottle and surrounding cylinder, the latter resting upon wrought iron bars supported by the edges of the furnace, and the former supported by a stone placed upon the grate of the furnace. Besides affording a support for the levers, the wrought iron cylinder was introduced to protect the experimenters against injury, should the bottle explode in the trials to be made with it. This apparatus having been placed in a quarry pit, adjacent to that in which the cylindric boilers were burst, water was poured into the bottle so as to fill it, the screw plug was next passed into the neck and forced home by lateral blows from a hammer: a fire was now made in the furnace, and the fuel heaped up so as to fill the entire space between the mercury bottle and wrought iron cylinder, and to be about five inches deep above the stopper of the former. A string was attached to the lever connected with the smallest plug, and carried up the bank. The fire soon burned briskly, and it was perceived that a small quantity of steam mingled with the feeble smoke and heated air which rose above the apparatus. About twenty minutes after the beginning of the experiments, the leak appearing to increase, an incautious attempt was made to stop it, but without success; at this time the bottle was seen to be at a dull red heat. It was thought that but little water had been able to escape in steam through the very minute opening which the imperfect thread of the screw gave, and it was intended to withdraw one of the plugs, when a few minutes should have elapsed to give time for the bottle to be heated to complete redness. Meanwhile a most violent explosion occurred, the body of the bottle rose in the air, the iron cylinder which served to increase the height of the furnace, was thrown from its place, the earthen furnace blown to pieces, and the fire scattered far and wide through the woods. After extinguishing the fire, it was found that the iron cylinder, weighing, with the apparatus connected with it,  $61\frac{3}{4}$  lbs, had been thrown four feet from its bed: the plugs which passed into the bottle had been broken short off at the exterior of the bottle; the bottom had been forced into the ground, which was ploughed up by the fragments of the furnace, and completely wet for a considerable distance around; one of the iron bars supporting the cylinder was thrown to a distance of thirty feet, and sunk three inches into the ground. The body of the bottle was found thirty yards from its position before the explosion, having penetrated two feet into the ground. The noise of the explosion resembled that of a twelve pounder fully charged.

This experiment proved, first, that steam, from intensely heated water, was able to penetrate an exceedingly small opening. Although it proved nothing in regard to an aperture made in a vessel containing water only, it showed an effect produced when there was very little steam in the vessel. It verified the deduction, from theory, that but a small part of water, highly heated, can expand into steam, if suddenly relieved from pressure. It showed that great danger must be incurred in attempts to heat water very highly, even in vessels where it has but little room to expand itself, contrary to the opinions entertained by many: and that an attempt to repeat the experiment of Perkins, unless with an apparatus capable of sustaining the most intense pressures, must be attended with great danger.

The wrought iron bottom of this bottle was welded upon the convex surface, and a portion of the welding appeared defective, but generally it was sound. The bottom having been torn from the convex surface, or from lateral portions, the strain was a transverse one, and, from calculation, could not have been less than ten atmospheres.

*X. To ascertain whether cases may really occur when the safety valve, loaded with a certain weight, remains stationary, while the confined steam acquires a higher elastic force, than that which from calculation would appear necessary to raise the valve.*

#### CONSTRUCTION AND GRADUATION OF THE SAFETY VALVES.

Of these there were two used at different times, the same in construction. They were disk valves, as shown in figure B, Plate 4, the valve seat was .515 inches in diameter, in each, and the diameters of the valves .70 of an inch. The stem *r*, to which the disk *p*, was attached, passed through the half collars *o* and *o'* which served as guides. On the point terminating the upper end of the stem, pressed the lever *l*, *m*, for receiving the weights. The fulcrum of the lever was a knife edge, resting in a curved opening in the upright *e*, which was screwed into the boiler. (See also K, Plate 1.) The apparatus was graduated by trial, in order that the friction might be duly estimated. The valve, lever, &c., being in place, a delicate balance beam *ff*, graduated to inches and tenths, on each side of the edge *g*, which was its axis, was so placed, fig. B, that one of the divisions was vertically above a small hole made in the valve stem; to this division a cord *h h'* passing through the hole, was attached. A scale pan was hung to a division *k*, of the opposite arm of the balance, and the string and pan made to balance by weights on the arm *fh*. The string being now stretched by a weight rather greater than the probable amount which it would have to bear in the graduation of the valve, the beam was made horizontal. Weights were then placed in the scale pan, until the weight of the lever, the stem and disk, and the friction, being overcome, the valve rose from its seat. This rise was indicated at the end *l*, of the valve lever, by an upright placed there for the purpose. Next a convenient weight was placed in the pan, and the point ascertained on the arm of the lever at which a small weight, assumed, balanced it. Thus several points were determined. In graduating the first safety valve *gh*, was 4.4 inches and *gk* 11 inches, so that the weight raised at *h* was two and a half that applied at *k*. The weight of the lever &c., balanced 24 oz. troy at *k*, or  $24 \times 2\frac{1}{2} = 60$  oz. = 5 lbs. troy at *h*. This weight rested on an effective surface of .515 inches in diameter, or .232 sq. ins. in area. It was equivalent, therefore to 24.04 lbs. troy to the square inch, or to 19.78 lbs. avoirdupois; that is to a pressure of 1.35 atmospheres of 14.68 lbs. corresponding to 30 inches of mercury.

A weight of 6 oz. being at  $d$ , near the end of the lever  $l m$ , was balanced by 56 oz. at  $k$  on the arm of the balance. To determine from this the ratio of  $d m$  to  $n m$ , we have  $\frac{56 \times 2\frac{1}{4} - 60}{6} = \frac{80}{6} = 13\frac{1}{3}$ , which coincided nearly with the ratio given by measurement, being a little in excess.

At the mark  $d$ , 6 oz. together with the weight of the lever, &c., and friction, produced a pressure of 3.14 atmospheres, and the weight used in the experiments, 9.369 oz. troy, produced a pressure of 3.27 atmospheres, exclusive of atmospheric pressure.

At the mark  $c$ , called in the experiments the *third* mark, 9 oz. balanced 56 at  $k$ , and the weight 9.369 oz. together with that of the lever, &c., produced a pressure of 2.63 atmospheres.

At the mark  $b$ , the *second* mark, 12 oz. were required to balance 56 at  $k$ ; the pressure produced by 9.369 oz. &c., was therefore, 2.31 atmospheres. At  $a$ , the first mark, 15 oz. balanced 56 at  $k$ , and the pressure from 9.369 oz. &c., was 2.12 atmospheres.

The experiments with these valves, will show why the committee are so particular in giving the data upon which the graduation was founded. The details in relation to the second valve were as follows.

The string from the valve stem was attached to the mark five, on the balance beam, and the scale to the mark ten on the opposite arm; when 29 $\frac{1}{2}$  oz. troy at ten, balanced the weight of the lever &c., at five. This weight was therefore 59 oz. troy or 4.04 lbs. avoirdupois: pressing upon a surface of .515 inches in diameter, or .208 sq. inches in area, it was equivalent to 19.44 lbs. to the square inch, or to 1.32 atmospheres of 14.68 lbs. At the last mark, near the end of the lever, a weight of 2 $\frac{3}{4}$  oz. balanced 49 oz. at the mark ten on the beam of the balance; the weight 3.76 oz. which was used in the experiments together with the weight of the lever, &c., produced therefore a pressure of 2.52 atmospheres.

At the mark next to the end, called in the experiments the second mark, the same weight together with the lever, &c., produced a pressure of 2.10 atmospheres.

Weights of 2.64 oz. and of 5.28 oz. were also prepared to be attached to the mark near the end, the weight of 3.76 oz. being prepared with hooks to adapt it to this purpose. The smaller weights produced an additional pressure of .84 of an atmosphere, and the larger of 1.68 atmospheres.

### *On the Performance of the Safety Valves.*

The committee, with a view to test the performance of the safety valve, selected the form calculated, in their opinion, to be most serviceable in practice, a disk valve. One of these valves was attached to the boiler. This was in action in the different experiments, and was tested by comparing with the temperature of the water within the boiler and with the steam gauge, when this latter was in use; the results were rendered more valuable from the fact that one of the valves having been injured in the experiments on highly heated steam, a second one had to be put in its place and to be graduated anew. The pains bestowed in this graduation enabled the committee, not only to compare the pressure at which the valve opened when similarly weighted in different experiments, but to compare the pressure given by calculation from the area of the valve, &c. with the actual pressure at which the valve allowed a free passage to the steam. Any adhesion of an unusual character could not have escaped detection. The valves were kept in good working order, but no unusual pains

were bestowed upon them, and the experiments ranged through more than two years of interval, irregularly continued. They therefore give quite as severe, if not a more severe, trial, than in a working apparatus. The following tables contain the results of the experiments and the comparisons, necessary to give an entire view of the subject.

The first column of the first table gives the observed temperatures of the steam, the pressure of which raised the safety valve, weighted as expressed in the third column; the pressures corresponding to these temperatures are given in the second column. An abstract of the first table is given in the second; it contains the mean, the highest and lowest observed pressures, and the range of pressure. The pressure at which the valve should have opened, according to calculation, and the ratio of the calculated pressure to the mean is also furnished by the last two columns of the same table.

TABLE FIRST.

Observed Temperature.	Corresponding Pressure.	Situation of Weight.	Observed Temperature.	Corresponding Pressure.	Situation of Weight.
Fah.°	Atmospheres.		Fah.°	Atmospheres.	
255 $\frac{1}{4}$	2.1	Valve without weight, except that of lever, &c.	281 $\frac{1}{2}$	3.4	Weight at second mark.
"	"		279 $\frac{1}{2}$	3.2	
260 $\frac{1}{4}$	2.3		283 $\frac{1}{2}$	3.5	
257 $\frac{1}{4}$	2.2		286 $\frac{1}{2}$	3.7	
253 $\frac{1}{4}$	2.1		281 $\frac{1}{2}$	3.4	
"	"		277 $\frac{1}{2}$	3.1	
251 $\frac{1}{4}$	2.0		279 $\frac{1}{2}$	3.2	
255 $\frac{1}{4}$	2.1				
271 $\frac{1}{2}$	2.8	Weight at first mark.	284 $\frac{1}{2}$	3.5	Weight at third mark.
272 $\frac{1}{2}$	2.8		287 $\frac{1}{2}$	3.7	
269 $\frac{1}{2}$	2.7		291 $\frac{1}{2}$	4.0	
277 $\frac{1}{2}$	3.1		283 $\frac{1}{2}$	3.5	
272 $\frac{1}{2}$	2.8		285 $\frac{1}{2}$	3.6	
276 $\frac{1}{2}$	3.1		285 $\frac{1}{2}$	3.6	
272 $\frac{1}{2}$	2.8				
277 $\frac{1}{2}$	3.1	Weight at last mark.	291 $\frac{1}{2}$	4.0	At last mark.
	2.8		292 $\frac{1}{2}$	4.1	
			297 $\frac{1}{2}$	4.5	
			293 $\frac{1}{2}$	4.2	

TABLE SECOND.

Weight.	Mean pressure.	Highest pressure.	Lowest pressure.	Range.	Calculated pressure.	Ratio of calculated to observed.
No additional weight	2.12	2.3	2.0	0.3	2.35	1.11
First mark	2.90	3.1	2.7	0.4	3.12	1.07
Second mark	3.36	3.7	3.1	0.6	3.31	0.98
Third mark	3.65	4.0	3.5	0.5	3.63	0.99
Last mark	4.2	4.5	4.0	0.5	4.27	1.02

The performance of this valve is shown by the table to have been so far satisfactory that the greatest range of pressure between the highest and lowest observations, at any position of the weight, is .6 of an atmosphere. While, therefore, no accurate investigation of the elasticity of steam could result from the use of such a valve, it is found to answer, so far as these results can show, the requirements of practice. In regard to the ratios of the average observed pressures to the calculated pressures, they range from .98 to 1.11, and at a mean the ratio is 1 to 1.034, a ratio which would produce, at higher pressures, marked differences between the calculated and observed pressures.

In a paper by M. Garnier, in the *Annales des Mines*,\* vol. 8, the results of his comparisons of safety-valves, having a considerable projection over their valve seat, with others having a small projection, are given, and are very worthy of attention. He found that a valve, the disk of which projected upon the valve seat beyond the opening of the seat .4 of an inch, opened at a pressure within the boiler, of only two-thirds of that shown by a mercury gauge, and that the distance to which the weight upon the lever of the valve required to be placed from the fulcrum, in another case, for a pressure of four atmospheres, was that corresponding to five atmospheres, if the pressure of the air on the upper part of the valve were estimated. With a disk projecting but .02 of an inch the ratio of the calculated pressure to the observed was 1.06 to 1.

The experiments above quoted, with a disk projecting .1 of an inch, give a less ratio than is indicated by M. Garnier, and show besides that the phenomena are not constant, the individual experiments varying more from each other than the mean varies from the calculated result. The fact developed by M. Garnier is attributed by him to a want of perfect contact between the disk and its seat, and the variations observed by the committee go to strengthen this opinion. Different positions of the disk, different states of its surface, and the interposition of small particles of dirt will satisfactorily account for the want of uniformity in the pressure at which the valve opened when all circumstances were *apparently* the same. Further evidence on this head will be gathered from the results furnished by the second safety-valve. This it will be recollected, was of the same form and dimensions with the first, and similarly graduated. In the following table the observed temperatures and pressures are given, at which the valve, circumstanced as stated in the column headed remarks, opened. The mean pressure, the highest and lowest pressures, and range, are given in the next four columns. The calculated pressure, and the ratio of the mean pressure to the calculated, are in the next two columns.

\* Second series.

TABLE THIRD.

Observed temp.	Corresponding pres.	Mean pressure.	Highest pressure.	Lowest pressure.	Range.	Calculated pressure.	Ratio of calculated to mean pressure.	REMARKS.
Fah °	Atmos.	Atmos.	Atmos.	Atmos.	Atmos.	Atmos.	Atmos.	
257 $\frac{1}{4}$ 259 $\frac{1}{4}$	2.2 2.3	2.25	2.3	2.2	0.1	2.32	1.03	} Up. No weight.
271 $\frac{1}{4}$ 271 $\frac{1}{2}$ 270 $\frac{1}{2}$ 275 $\frac{1}{2}$	2.8 2.8 2.7 3.0	2.77	2.8	2.7	0.1	3.10	1.03	Leaks badly. One weight at 2d mark. Valve up.
277 $\frac{1}{2}$ " " " " 279 $\frac{1}{2}$	3.1 " " 3.2	3.1	3.1	3.1	0.0	3.52	1.09	Not fully up. Weight at end. Valve up.
286 $\frac{1}{2}$	3.7					4.36	1.10	One additional weight.
296 $\frac{1}{2}$ 299 $\frac{1}{2}$	4.4 4.6	4.5	4.6	4.4		5.20		Leaks freely. Two additional weights. Leaks freely.
305 $\frac{1}{2}$ 307 $\frac{1}{2}$ 308 $\frac{1}{2}$	5.1 5.3 5.4	5.27	5.4	5.3	0.1	6.04	1.15	Leaks freely. Three additional weights. Up. Up.
313 $\frac{3}{4}$	5.9					6.88		Leaks. Four additional weights.
317 $\frac{3}{4}$ 319 $\frac{3}{4}$ 319 $\frac{3}{4}$	6.3 6.5 6.5	6.5	6.5	6.5		7.72	1.19	Leaks freely. Five additional weights. Up. Leaks freely. Marked 4 wts. but was probably 5.
327 $\frac{3}{4}$ 333 $\frac{3}{4}$ 329 $\frac{3}{4}$	7.3 7.9 7.5	7.6	7.9	7.3		8.56	1.13	Leaks. Six additional wts. Up. Leaks.
338 $\frac{1}{4}$ 344 $\frac{3}{4}$	8.3 9.0					9.85		Leaks. Six additional wts. and four oz. troy.
351 $\frac{1}{2}$	9.8					11.12		Leaks. Six additional wts. + eight oz. troy.

The weights used in the experiments were verified after their conclusion, and found to be accurate. The ratios of the calculated pressure to the observed increase, and afterwards decrease, showing that the results are not attributable to inaccuracy in the unit of weight which was successively applied. They are not explicable by a defect in measuring the valve seat, as is shown by the nearer coincidences at the lower pressures, when the ratios are much nearer to unity than in the higher.

This valve was fitted, by grinding, twice during the experiments, but that the contact with the seat was not perfect, is shown by the number of times at which leaking is noticed before the rise of the valve; these leaks at the high pressures became very sensible, and increased rapidly, from the instant of their first appearing, to that at which the valve opened.

The mean ratio of the calculated to the observed pressure is 1.10 to 1, but taking for comparison with the first valve, the same range of pressures as was calculated for the first, the ratio is as 1.04 to 1, differing but little from the ratio obtained for the first valve.

This defect in the safety-valve, which affects its use as a means of judging of pressure in proving boilers, is increased as the pressure increases, and may cause an inadequate proof by the forcing pump, or the hydraulic press. No adhesion of an undue kind is shown, by these experiments, to have taken place with the second valve, the difference of pressure of opening and of undue leakage, under similar circumstances, being moderate. The experiments, it should be remembered, apply only to disk valves, and not to those of a conical form.

*XI. To ascertain, by direct experiment, the effect of deposits in boilers.*

The committee have been fortunate on this head in obtaining the account of the results, on a large scale, furnished by the deposits in the boilers of boats on our western waters; to these they refer, as showing,—

1. That deposits, consisting of sedimentary matter, carbonate of lime, and other salts, collect in particular parts of boilers, and, preventing the communication of heat to the water, are baked hard, becoming “as hard as brick,” when the water is low.\*

2. That these collections of mud, &c. may, by causing the undue heating of the bottom of a boiler, produce exfoliations of oxide, which gradually reduce the thickness of the metal; or they may allow the temperature of the metal to be raised so high, that it swells out by the ordinary pressure of the steam, and finally bursts. Thus leading, gradually or suddenly, to the weakening the boiler, and to the discharge of its contents.†

The committee have also examined cases of similar deposits in iron boilers, using spring (hard) water. They consisted chiefly of the carbonates of lime and iron, mixed with oxide of iron, containing, besides, the earthy salts from the water. Unless removed at short intervals, they form in the ordinary use of the boilers, and without undue heating, exceedingly hard crusts upon the bottom of the boilers, requiring the aid of the chisel for their removal. Retarding the passage of heat into the boiler, they lead to a great waste of fuel; and exposing the bottom to be unduly heated, they destroy the boiler gradually, by wear, if not suddenly, by explosion.

The nature of these deposits, and the rapidity of deposition, varies, of course, with the kind of water which is used.

[TO BE CONTINUED.]

\* Explosion of boiler of steamboat Caledonia, W. Littlefield, p. 310, vol. viii., Jour. Frank. Inst. Anonymous, p. 310, ib. Matthew Robison, p. 311, ib. E. W. Benton, p. 314, ib. Also, L. Hebert; p. 379, ib. Thos. W. Bakewell, p. 386, ib. Thos. J. Halderman, p. 28, vol. ix.

† Col. S. H. Long, pp. 244–5, vol. viii. Prof. Johnson, at monthly meeting of Institute.

*On Calcareous Cements.* By JAMES FROST, Civil Engineer.

## No. III.\*

The affinities of lime for the following substances have been classed by chemists, and seem to have been neglected by them as of little importance, or interest; this has probably arisen from their feeble action at low temperatures, and from chemists not being aware of the value of the investigation. As the temperature increases, the affinity of lime increases for all the substances named, becoming at length very intense. Under atmospheric pressure only, at a bright red, or nearly white heat, in the dark, water and carbonic acid separate from lime without decomposition; under increased pressure, they remain in combination, the carbonate of lime forming into a solid, resembling marble. As the temperature increases, the other substances combine with the lime, and undergo partial decomposition, losing oxygen, which is taken by the lime, and retained by it at common temperatures. This fact, and some other curious laws, have been hitherto unregarded, yet will be found of great importance to the right understanding of the subject we have in hand.

The affinities of lime are regular and constant, as must be expected by all who understand chemistry; they are in the following order.

For Protoxide of Silicium.

For " of Manganese.

For " of Iron.

For Carbonic Acid, or Deutoxide of Carbon.

For Silex, or Peroxide of Silicium.

For Alumine.

For Water.

When we examine the lowest of these affinities, that of water, we shall find it of surprising energy; yet, great as it is, and greater as the preceding ones must necessarily be, as they all displace it, these immense forces are singularly limited by some curious laws, which I shall hereafter endeavour to develop, and also to show, in detail, the peculiar action of magnesia, soda, potassa, hydrogen, sulphuretted hydrogen, carbon, &c., which, in many cases, exerting peculiar and important influences, will, of necessity, require considerable detail. Indeed, when it is considered how many elements are included in these combinations, the necessity of detail will be apparent, to render them easily understood, and extensively useful.

When pure lime is moistened with pure water, twenty-eight parts of lime enter into chemical combination with nine parts of water, and form what is termed hydrate of lime. Any superfluous water may be readily expelled from the hydrate, by exposing it to a heat a little above that of boiling water; but the nine parts of water remain fixed at a red heat, and require a heat white in the dark for their expulsion. When the substances are pure, and in sufficient quantity, they become instantly red hot on admixture; a fact well known by the frequent accidental firing of combustible matter in this way. That this combination is permanent at a red heat, may be easily proved by trial, and that it requires a more intense heat for their separation, is evident from the following experiment. 100 grains of hydrate were enclosed in a small platina crucible, to which a cover was luted, having only

\* No. 2 was published in the December number of this Journal, vol. xvi, p. 377.

a small tubular aperture in the centre, and being placed in a reverberatory furnace, at a white heat, became equally hot in five seconds; after the lapse of a minute, a cold iron bar was held, for a few seconds, over the aperture of the crucible, and on withdrawing the bar, a drop of condensed water was appended to it; at intervals of a minute, other bars exhibited the same appearance for nearly a quarter of an hour.

The great heat developed in slacking lime, has been hitherto attributed to the latent heat of the water being set at liberty on its assuming a solid form in the hydrate. Now, the heat that ice absorbs in becoming fluid, is  $140^{\circ}$ , but the red heat of the water in the hydrate is at least  $700^{\circ}$  and as the lime is also heated to the same degree, and as the specific heat of lime, compared to that of water, is as .2199 to 1, if we multiply the latent heat of the former by  $3\frac{1}{3}$ , we shall find the heat of the lime,

	467
	<hr/>
	1167
Deduct the latent heat of water,	140
	<hr/>
Remaining unaccounted for,	1027

Being more than seven times the latent heat of water, and which we must leave unaccounted for at present.\*

That water is not decomposed in combining with lime, is proved by heating one hundred grains of hydrate in a platina retort, connected with an air-tight condenser, expelling the water from the hydrate, and, when cool, returning the same water on the same lime, several times in succession; no extrication of hydrogen, or sign of decomposition, will occur. As the water held by lime at a red heat, would, if not so held, form steam of immense elasticity, it follows that the cohesive force of lime and water is a still greater force. This expansive force of red hot steam has been differently stated by Rumford, and by Perkins; the lowest statement of the former is 50,000 atmospheres to the superficial inch, more than twelve times the cohesive force of bar iron. What a wonderful exhibition of the power of chemical attraction!

The same compound is formed when lime is exposed for a length of time to the air, from which it certainly, though slowly, absorbs the vapour that may be present in it, and, as we shall hereafter see, with the same proportionate extrication of heat, although, being so slowly extricated, it has hitherto escaped observation by our senses, or by our instruments. Lime, thus air-slaked, as it is termed, also absorbs carbonic acid, and is thus injured, in some degree, for good mortars, and this fact is pretty well appreciated. But its absorption of oxygen seems to have been little regarded, although it is the great source of its use for medical purposes; it is a fact, however, that lime absorbs in slacking, and subsequently as a hydrate, a considerable quantity of oxygen, and hence its use in disinfecting; for, by absorbing oxygen, it liberates nitrogen, which, combining with putrid miasmata, renders it innocuous, or neutral, and, if carefully used, is probably as useful an article as the more expensive, and less well known substances, used for that purpose; but all these absorptions, however useful for particular purposes, are injurious, where good mortar is the object required.

These absorptions of gas are visible by slacking some lime in a cup float-

\* Our correspondent here assumes that water, in combining with lime to form a solid, is in the same condition as when frozen; a conclusion which seems untenable.

ing on water, and covered with an inverted glass jar, furnished with an opening, and a stop cock, to equalize the internal and external pressure of the air; on closing the cock, the water will be found to ascend in a jar containing atmospheric air, or oxygen gas, and to be stationary in a jar filled with hydrogen. As we shall pursue this investigation with more advantage in a similar examination of cements, we will now proceed to see how easily this intense action between water and lime may be modified, delayed, or suspended, and to show that the art of doing so was known at a very remote period—has been long lost or abandoned—perhaps, on the use of gypsum, being discovered; and how the art may, if revived, be prosecuted with more advantage, or be superseded by improved modes.

As it is necessary, in all admixtures of two or more solid substances, for the purpose of forming any new chemical compound, that their respective particles be previously reduced to an impalpable or indiscernible state, we shall, in future, always consider this as having been effected.

If 100 grains of chalk-lime be mixed with 200 grains each of the substances named in the following table, be tempered with water to the consistence of mortar, and be placed on a plate of glass, they will exhibit the appearance indicated in the table, previous to slacking; and if the quantity of many of the substances is further increased, the lime will not slack at all in dry situations; but, however the other substances may be increased in quantity, or the lime be varied in quality,—however near they may be thus made to approach in appearance to real cements, they will always be found false cements, by immersion in water, as, either on setting, or at considerable and uncertain times thereafter, they fall in pieces, and are likely wholly to disintegrate.

The second column indicates the time occupied in setting to resist a moderate impression of the finger, and the temperature of compound; the third and fourth columns, the times occupied in attaining sufficient hardness to receive a visible mark from a black lead pencil, and of a leaden point; the fifth, the time occupied in slacking, or falling to pieces, which they did, as it were, inside, while hardening externally; indeed, some attained sufficient hardness to receive a distinct mark from a brass point, while becoming rotten internally.

Substances.	Set in	Black Lead.	Lead.	Slacked.
Cast-iron,	1 minute, hot			15 minutes.
Wrought-iron,	5 minutes, hot	5 minutes		6 minutes.
Emery,	4 minutes, hot		2½ hours	7 minutes.
Glass,	10 minutes, warm	15 minutes	4 hours	3 days
Copper slag,	12 minutes, warm	20 minutes	20 hours	9 days
Deutoxide lead,	9 hours, cool	12 hours		24 hours
Peroxide iron,	35 minutes, tepid	40 minutes	3 days	50 minutes
“ manganese,	50 minutes, tepid	105 minutes	75 mins. tepid	
“ tin,	30 minutes, tepid	40 mins. tepid	3 days	10 days
Silicious sand,	2 minutes, hot	3 minutes	14 hours	
Calcined pure alumina,	3 minutes, warm	5 minutes		
Calcined magnesia,	Never remade at 2 days	4 days	10 days	
White marble,	8 minutes, warm	12 minutes	3 hours	4 days
Chalk,	15 minutes, warm	30 mins. hot		65 minutes
White marble, 300,	30 minutes, cool	1½ hours hot	6 days	Permanent
Chalk, 300,	25 minutes, cool	40 mins. tepid	4 days	Permanent

The ancients were, doubtless, in the habit of using cements like the last

two. A friend, Mr. Bignell, brought me, three years since, a fragment of an enriched ceiling from Pompeii, which he saw in a state of great preservation; on analysis, I found it a nearly pure carbonate of lime, and, while sound, as hard as alabaster; perfectly free from those minute cracks always found in hydrate compounds of lime, formed from pure carbonates.

I have entered rather fully on this subject, not only to illustrate an intricate branch of science, but to give a warning against the use of certain mixtures under the impression that they are useful cements; these, we shall find, may be abundantly procured from many sources hitherto unknown, certain in their action, and cheap in their formation. Before I abandoned the investigations undertaken for finding some useful compound, similar to the last, I tried the compounds of lime with charcoal, coke, sulphur, various metallic oxides, stones, raw and calcined clay, mixtures of alcohol, acetic acid, sugar, treacle, and oils; all of which have the property of delaying, or suspending, the chemical combination of lime and of water, but none led to any useful results.

We will now endeavour to see the real nature of water mortars, or mixtures of pure limes with various substances with which they harden under water, with more or less rapidity; when withdrawn from water, they sometimes continue to harden, sometimes cease their hardening, and sometimes, as it is said, unhardens; we will not only endeavour to show how this arises, but show, also, how any one may easily understand these facts, and compare the action of any substance hitherto untried, with those that have been long and well known.

When pure lime is immersed in pure water, it is readily dissolved, provided no more lime is introduced than will saturate the water; and if, in any saturated solution of lime, any lime remains undissolved, and any of the lime in solution is withdrawn by the chemical action of any substance introduced into the solution, the water immediately takes up another portion of the undissolved lime, and always continues in a saturated state. The solution, when exposed to the atmosphere, quickly becomes covered with a crust of carbonate of lime, which defends the solution from farther admixture of carbonic acid; and thus the actions about to be described, take place by virtue of chemical affinities between the lime and water, and other substances, without combination with, or any reference to, carbonic acid, which we shall hereafter find to have peculiar and independent affinities; should any doubt remain on this subject, the experiments may be repeated, with the same results, in air-tight glass jars.

It has long been known that tarras, which is principally a silicious substance, and puzzolano, which differs from tarras, principally, by containing a little more oxide of iron, will, each of them, when reduced to an impalpable state, and well mixed with an equal weight, or more or less, of pure hydrate of lime, and tempered with water to the consistence of mortar, and placed under water, gradually concrete, harden, and become like stone; that, if withdrawn from the water, they almost, or altogether, cease from hardening, and, if returned to the water again, continue to harden to a great degree. It is not so well known, but is equally true, that they may, by merely beating them up, or turning and well chafing up with a shovel, at frequent intervals of a few days, be kept under water, or in moist situations, for a great length of time, without hardening, and without any injury whatever to their subsequent hardening when replaced under water, and suffered to repose; for, though these substances harden greatly in time, say a year, yet the hardness they acquire is almost imperceptible,

say in ten or twelve days; and frequent and thorough stirring of them always restores their original plasticity.

It is also well known that hydrate of pure lime, tempered with water to the consistence of mortar, with any quantity of silicious sand, and placed under water, will never harden, but, on the contrary, if placed in a current of water, the lime will be wholly dissolved, and carried away; but it is also equally true, that if the silicious sand is reduced to an impalpable state, previous to, or after, admixture with the hydrate, the mixture will harden gradually under water; and it is also equally true, that a similarly formed mixture of hydrate, and of calcined pure alumina, will harden under water, and that neither of these substances harden so readily, or so much, under water, as tarras, or puzzolano, which are both principally composed of them, as will be seen by looking at the analysis of these substances, which I shall hereafter give; nor will a mixture of silica and pure alumina, in the proportions in which these substances are found in clays, (pipe clay, for instance, being a compound of one part of alumina, and three of silica,) calcined or uncalcined, be found to set and harden, when tempered with lime, and placed under water, so well as those substances do separately, as before stated; but they all do harden, more or less. We will hereafter explain the cause of their different behaviour; at present, we will endeavour to show why or how, they harden at all.

Chemists have stated as a general law, that when any two substances enter into chemical combination, one or both of them must be, at the time, in a state of fluidity. I have never seen it stated, but, from long consideration I believe it to be the fact, that when three or more substances enter into chemical combination, two or more of those substances must be then, or have been at some previous time when in contact, in a fluid state.

Now, to apply this law, is to explain the rationale of the hardening of water mortars. The hydrate of lime, a solid, is mixed with the tarras, or puzzolano, or, in other words, is associated with silex, another solid, and placed in fluid water; now, the lime is soluble in this water, and its solution, coming into contact with the remaining solid, (silex,) for which lime has a greater affinity by far than for water, it quits the water, and attaches itself to the silex, and the water, being again at liberty, dissolves another portion of lime, to be again, in its turn, attached to the silex; and, in favourable circumstances, this proceeds till the soft mixture is indurated, and becomes a hardened mass.

That this is a true and faithful representation of the wonderful change produced in these substances, is rendered undeniable by the following experiment, which I made to test the opinion just given.

Into a basin of water, was introduced a plate of glass, on which was laid small and separate particles of coarse grains of tarras, of puzzolano, of silex, of alumina, of protoxide of iron, or common forge scales, of coarse fragments of Roman cement, and other substances likely to attract the lime, and to concrete with it into masses; and on another part of the glass was laid a small piece of quick-lime, which, slacking, was dissolved by the water; the water soon became saturated with lime, covered with a protecting coat of carbonate; the lime was attracted with more or less force to the different, distinct, and distant substances, from the water, and there were, after the lapse of a few days, found concrete masses of lime, and of the respective substances, more or less advanced in hardness, and the hardness so obtained was in direct proportion to, and was an evident measure of, their respective

affinities for lime; and are evidently, also, superior to that existing between lime and water. Now, this experiment accounts perfectly for the hardening of water mortars, for their ceasing to harden when withdrawn from water, and for their again continuing to harden when replaced in water. Why they sometimes continue to harden out of water, and sometimes to retrograde, as well as why tarras and puzzolano harden better than the principal elements of which they are composed, whether those elements be combined or uncombined, will all be satisfactorily shown when we have made some necessary farther advances in our inquiries.

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*On Surrendering and Renewing Patents under Amended Specifications. By the Editor.*

In the last volume of this Journal, p. 313, in noticing a patent obtained by Mr. C. J. Gayler, of New York, for manufacturing iron chests, we remarked that the patent originally issued to Mr. Gayler for these chests, had been vacated in the District Court of the United States for the Southern District of New York, in consequence of defects in the specification, and expressed a doubt whether, under these circumstances, the new patent could be sustained. By referring to the notice here alluded to, the reader will find a brief statement of the grounds upon which that doubt was founded. Our attention has been since called to this subject, and upon further reflection we are apprehensive that our first impressions upon this point may prove to be incorrect; we have also conversed with two gentlemen of the bar respecting it, who believe that a patent which has been declared void by a court, may, under the act of July 3d, 1832, be surrendered to the Secretary of State, and reissued under an amended specification. This act provides that whenever a patent "shall be invalid or inoperative, by reason that any of the terms or conditions prescribed in the third section of the act [of February 21st, 1793] have not, by inadvertence, accident, or mistake, and without fraudulent or deceptive intention, been complied with on the part of the said inventor, it shall be lawful for the Secretary of State, upon the surrender to him of such patent, to cause a new patent to be granted," &c.

All the patents which had been surrendered subsequently to the passing of this act, and prior to that by Mr. Gayler, were, we believe, surrendered upon a conviction existing in the mind of the patentee, that he had not complied in the first instance with the requirements of the law, and that his patent would not, therefore, be sustained if carried into court. There does not, however, appear, in the wording of the law, any thing to prevent the surrendering of a patent after it has been declared void by a jury, as this does no more than prove it to be "invalid and inoperative," and appears, therefore, to place it in the precise condition in which the relief contemplated by the act is to be afforded. Until this has been done, the patent is not absolutely "invalid and inoperative," however strong the conviction may be that such would prove to be its condition, if subjected to the ordeal of the law.

The foregoing view of the operation of the law appears to be much more consonant with justice than that first taken by us, as a patentee might, undoubtedly, surrender his patent, had his errors been discovered by himself, or by his friends, and it would be no small hardship, were the remedy denied because they had been detected by an adversary.

It may be proper to observe, that a reissued patent stands precisely upon the same basis with that originally obtained; that is to say, the surrender and reissuing do not of themselves give to it any validity, but only afford an opportunity to render it valid. The patentee may still claim more than he has invented, or the whole thing patented may be without novelty, and stand no better chance of being sustained than it did in the first instance. We could point to several reissued patents, which we believe to be in this predicament, and which must remain so, until the Ethiopian can change his skin, and the leopard his spots.

## Physical Science.

*Essays on Meteorology.* By JAMES P. ESPY, Mem. Am. Philos. Soc., &c.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—I send you now, for publication, the first of a series of essays on rain, hail, and snow, water-spouts, land-spouts, winds, and barometric fluctuations, in which, I hope, it will be found that I have successfully traced these phenomena to their true causes.

The announcement that these essays were about to be published, was made in a communication of mine, in the Journal of the Franklin Institute, in 1834, and they have only been withheld with a view to accumulate such a mass of facts, as would place the theory on an immovable foundation. Such a mass has now been collected, and I promise the reader, in advance, that he will find developed in the following essays, a law in meteorology, which, founded on acknowledged dynamical principles, explains at once, with a simplicity which nothing but nature can equal, all the *seven* phenomena mentioned above.

The importance of this law will readily be admitted, when it is understood that by it may be known whether there is a great storm raging at any time within four or five hundred miles of the observer, and also the direction of that storm, with the means of avoiding it, if the observer is at sea.

Yours, &c.

JAMES P. ESPY.

### No. I.

#### *Theory of Hail.*

It has been shown by the experiments of Berard and Delaroche, and also by those of Clement and Desormes, that the specific heat of atmospheric air is about .250, that of water being one.

Now, if these experiments are correct, and they appear to be so, it will be easy to account for the formation of rain, snow, and hail, and several other atmospheric phenomena, which have never yet been satisfactorily explained.

The theory of these meteors may be given in a few words. When a portion of transparent vapour, in the air, is condensed into cloud, or water, *the latent caloric given out expands the air containing it six times as much as it contracts by the condensation of the vapour into water.*

This general principle will be most easily explained by calculating a particular case. Suppose the weight of vapour in the air to be one-sixty-fourth that of the air, which is the fact when the dew-point is about 71° Fah. Now,

if all this vapour should be removed from the air, the diminution of bulk, on the supposition that the specific gravity of vapour is .625°, that of air being one, would be .045 of the whole.

As it is known that the sum of the sensible and latent caloric of the vapour of water is always equal to 1212° Fah., if we subtract 71°, the dew-point assumed above, from 1212°, it will leave 1141° for the latent heat of vapour at the temperature of 71°. As this latent heat would raise the temperature of sixty-four times its weight of water, 17.8°, it will raise the air in which it is supposed to be condensed, four times that quantity, or 71.2°. Now, if air at the temperature of 32° be raised 71.2°, it will be expanded 0.15ths of its whole bulk, nearly, which is six times its contraction from the condensation of its vapour into cloud, or water.

The calculation here made is undoubtedly low, for the mean temperature of the air to which it is intended to apply, as will be seen hereafter, is below 32°, and though the capacity of air is increased by a diminished pressure, yet it is believed that that increase will be more than counterbalanced by the 140° of heat given out, in the case of hail, at the moment of congelation, for which no allowance is made in the above calculation.

It follows, then, from the principle here demonstrated, that the moment a portion of transparent vapour in the air begins to condense into cloud, the air in which it is contained begins to expand, and, consequently, if an equilibrium existed before, it is now destroyed, and the cloud will continue to ascend as long as its temperature is greater than that of the surrounding air.

Without examining its condition every instant of its ascent, let us imagine it to have ascended three miles and a half, or 6000 yards, where the pressure of the surrounding air is about half that at the surface from which we suppose it to set out. In consequence, then, of occupying a double space, the dew-point would be 50°, provided none of the vapour is turned to water. On the same supposition, the temperature of the air would fall, in consequence of expansion, one degree for every hundred yards of ascent, if it preserved the same relative temperature to the surrounding air which it had at first, and its temperature would then be 11°. But this temperature is impossible with a dew-point of 50°, for the temperature could not fall below 50°, without bringing the dew-point with it.

From necessity, therefore, the dew-point must fall below 50°, to a point where latent caloric enough is evolved by the condensation of vapour, to heat up the air from 11° to that point.

I find, by calculation, that if the dew-point sinks sixteen degrees below 50°,  $\frac{1}{17\frac{1}{2}}$ ths of the whole vapour in the air will be condensed, and this will heat the containing air 23 degrees, the excess of which over the 16 degrees of depression will make up the difference between 11° and 50°. Thus it appears that the temperature of air, when it has ascended 6000 yards, with a dew-point of 71° at its commencement, will have a dew-point of 34 degrees, and be 23 degrees warmer than the surrounding air at that elevation. In like manner it may be shown, by assuming other points at greater elevation in this upward motion, that the difference of temperature between the air in the vortex, and the surrounding air, is constantly increasing with the elevation, until the moment when the vapour is all condensed into water, when it will be 71.2° higher, as was shown before. After it passes this point, it will continue its motion upwards, *dry*, and, of course, not increasing in temperature beyond 71.2° higher than the surrounding air, but will

preserve this difference until it reaches the surface of the atmosphere, where it will spread itself out, and come to rest. We have now a column of air reaching from the surface of the earth to the surface of the atmosphere, of the same temperature as the surrounding air below, and  $71.2^{\circ}$  greater above, making a mean of  $35.6^{\circ}$ . Now, the mean temperature of the surrounding air may be taken as low as  $32$  degrees, and, consequently, the expansion due to these  $35.6^{\circ}$  will be  $\frac{35.6}{480}$ ths of the whole height of the atmosphere; and as the atmosphere would be  $27,000$  feet high, if it were throughout of the same density as at the surface of the earth, the expansion will be  $\frac{35.6}{480}$  of  $27,000$  feet =  $2070$  feet. This vortex column, then, is pressed upwards with a force equal the weight of a column of air of the density at the earth's surface,  $2070$  feet high, and will move upwards, as is demonstrated in mechanics, with a velocity in feet per second =  $\sqrt{2070 \times 8} = 364$ , which is  $4.13$  miles per minute, or  $218$  miles per hour. Nor is this great velocity at all incredible, for the upward motion in the vortex is as much greater than the horizontal motion of the air towards the vortex, as the motion of the air in a chimney is greater than the horizontal motion of the air in the room towards the fireplace.

I am aware that several corrections would have to be made to the numbers used above, if strict numerical accuracy were my object. For example, it is probable that the air in the higher regions contains, as Mr. Ivory asserts, more caloric to the pound than in the lower regions, for it is the upper air which receives the latent caloric given out in rains, and snows, and hails; but this correction would vary the result so little, that, for the sake of simplicity, I have chosen to neglect it. Besides, the truth of the theory does not at all depend on the numerical accuracy of the above calculation. It is believed, indeed, that the latent caloric given out by congelation, would, after all the other corrections were made, be sufficient to turn the scale in its favour; but, even if it should be found otherwise by a closer investigation than I propose now to give the subject, the truth of the theory cannot be touched, unless it shall be discovered that the experiments on the specific caloric of atmospheric air, mentioned above, are erroneous to a degree altogether incredible. For, if the capacity of air should be found to be four times as great as supposed above, I find, even then, that the latent caloric given out on the formation of a cloud, would cause an expansion just double the contraction from the condensation of the vapour, and *that*, too, without the assistance of the caloric given out by congelation. And even this small expansion, calculated on the principles laid down before, would give an upward velocity of  $100$  miles per hour.

As the result here deduced is so extraordinary and unexpected, it will, no doubt, excite chemists to determine, with the greatest care, the specific caloric of atmospheric air, as this is the only point concerning which any doubt remains, on which the theory advocated depends. The latent caloric of vapour, the expansion of air by heat, and its velocity upwards for a given expansion, are perfectly known.

In the meantime, let us see how the theory will explain the phenomena. It is confidently believed that no theory will stand the test of examination, which will not show how, in the case of hail, drops of rain are first formed, and then frozen. This theory readily accounts for this circumstance; for, when the dew-point is high, and near the temperature of the air, condensation of the vapour into drops of rain will take place near the surface of the earth, in the ascending vortex, and these drops will increase in size until they are carried up far beyond the region of perpetual congelation, where

they will be frozen. That very large drops will be carried up while they are in the ascending vortex, will readily be admitted, when it is recollected that the velocity of the ascending vortex was demonstrated to be about 364 feet per second, even when the dew-point was taken at 71 degrees. If the dew-point had been taken at 80 degrees, a much greater velocity would have been the result. It is known by experiment, that when common atmospheric air moves with a velocity of one foot per second, its impulse on a square foot of surface, perpendicular to its motion, is sixteen grains; and as the force of all fluids is as the square of their velocity, the force of air in the vortex, on the supposition of its density being equal to common air, would be  $364^2 \times 16$  grains, about 361 lbs. on each square foot of surface. But as the air in the vortex, at the height to which hailstones may be carried, is probably not more than one-third the common density, the actual force of upward impulse, at this great elevation, is only one-third of 361 pounds to the square foot; a power still sufficient to raise a cube of ice one and a half feet in diameter.

I hope it will not be considered a decisive proof against my theory, if it fails to account for hailstones, said to have fallen in the reign of Charlemagne, fifteen feet long, six feet wide, and eleven feet thick; nor of those which fell, or are said to have fallen, in the reign of Tippoo Saib, as large as elephants; for these accounts are probably exaggerations.\* And yet, if we suppose the vortex perpendicular, and the dew-point high, its power would be sufficient to raise an elephant some distance, but certainly not so high as the region of perpetual congelation. We have certainly many authentic accounts of hailstones weighing half a pound, and more. Pouillet has given an account of a hail storm which extended from the Pyrenees to the Baltic, on the 13th of July, 1788, in two bands, parallel to each other, about fifteen miles apart, in which space there was a great rain. The eastern band was, at a mean, about six or seven miles broad, and the western about twelve miles. The rain, however, was on the outside of these bands of hail, as well as between them. The progress of the storm from the south-west to the north-east was about fifty miles per hour, and the hail continued to fall not more than eight minutes at any one place, yet the devastation was immense, the largest of the hailstones being about eight ounces.

If I had made this storm myself, it would be said that I had made it to illustrate my theory. For it is manifest that the out-spreading of the vortex above, will, in many cases, carry with it the hailstones, and those which are least the farthest, and these smaller hailstones, on the outside of the bands, will melt before they reach the earth, while the larger hailstones, falling more swiftly, and having more ice to melt, may reach the earth in the form of hail. Thus the two veins of hail, and the rain on the outside of them, are manifestly accounted for; it is not quite so plain why it should only rain in the middle. Nevertheless, if we consider that the vortex moved with a velocity of fifty miles an hour from the south-west to the north-east, we will readily perceive that, as it would require perhaps twenty or thirty minutes for the drops of rain to be carried up to their greatest elevation, and to fall down to the earth, during which time the vortex would move forward twenty or twenty-five miles, neither hail nor rain could appear in front of the vortex, and as it could not fall in the middle of the vortex, being prevented by the force of the ascending air, whatever fell between the two bands of hail

\* Pouillet, vol. iv., p. 836, et seq.

must have descended in the hinder part of the vortex, where the resistance might have been so great to its descent in the lower parts of the air, as to cause it to melt before it reached the earth.

The correctness of this explanation acquires additional probability from the fact that, in hail storms, the hail almost always precedes the rain, as appears from the facts collected by Pouillet. After mentioning the facts connected with this remarkable storm, this highly enlightened philosopher says: "In explaining the meteor hail, there are but two difficulties, but these are great, and we may say, in advance, they remain above all the efforts which have been made to resolve them.

"First. To explain how the cold is produced which congeals the water, and then to show how a hailstone which has acquired sufficient volume to fall by its own weight, remains yet suspended in the air during all the time necessary to acquire a volume fourteen or fifteen inches in circumference."

These two difficulties have already been fully explained. But the power of the theory does not stop here. It explains all the showers of dust, and rains of blood, (which are only water holding clay in solution,) of which we have a great many well authenticated accounts. For, when the vortex reaches down to the surface of the earth, it is able to carry up large quantities of earth, as will appear from the following extract: "On the 6th of July, 1822, at 35 minutes past 1 o'clock, P. M., in the plain of Ossonville, six leagues WSW. of St. Omer, and six leagues SE. of Boulogne, clouds were seen coming from different directions, and uniting together rapidly over the plain; they soon formed but *one*, which covered the horizon. An instant after, they saw descend from this cloud a thick vapour, having the blueish colour of sulphur in combustion; it formed an inverted cone, whose base was in the cloud. After it passed from that place, it was discovered that it had made an excavation in the earth, in the form of a basin, twenty or twenty-five feet in circumference, and three or four feet deep in the middle. After tearing down a barn, and some trees, it passed on, a distance of two leagues, without touching the earth, carrying with it large branches of trees, which it threw out to the right and left with much noise. Having then arrived at an elevated wood, it tore off the tops of many oaks, and carried them over the village of Vendome, situated at the foot of the hill, on the east side of the forest. In this commune, it tore up by the roots a large sycamore, and carried it 600 yards. The meteor, during its whole course, was like a bullet, which strikes the earth, and rebounds, tearing up the earth in places, and from time to time throwing out from its centre globes of fire, and globes of sulphurous vapours, and branches of trees. In the village of Witcanestre, of forty houses, thirty-two were prostrated, with their walls all thrown outwards, and at Lambre, eighteen, chiefly built of bricks, were sapped to their foundations in the same extraordinary manner." Nothing is said of either hail or rain accompanying this meteor.

Another spout, almost exactly similar to this in violence, took place near Treves, on the afternoon of the 25th of June, 1829. Suddenly, from the middle of a black cloud, about 20° above the horizon, a luminous mass began to move in an opposite direction, and to tear it open violently. The cloud near the top very soon took the form of a chimney, from which escaped a smoke of a whitish gray, mingled, at intervals, with jets of flame, and rising through several openings, with as much force (so several witnesses express themselves) as if it had been driven with great force by several bellows. It had not gone far, when a new meteor, as some thought, appeared

in contact with the ground, nearly under the other, though a little behind, and producing great destruction.

One man, who was prostrated by the spout, affirms that there were two currents, in contrary directions. The path of the meteor was from ten to eighteen yards wide, as marked on the earth, and about 2100 yards long. It lasted about eighteen minutes, and, as seen at the distance of a mile and a half, it had the form of a serpent, of a hundred and forty feet long, with its head towards the NNE., and its tail opposite. It disappeared suddenly, and without explosion, and, almost immediately afterwards, hailstones of extraordinary size fell in the woods, to the NNW. of the place where the spout had passed. The sun did not appear during this whole time, and there was not a breath of air; at least, so several of the spectators affirm.

The various phenomena accompanying these two spouts seem to me to favour, in a most remarkable manner, the fact of upward motion; especially the manner in which the houses were prostrated by the first. Indeed, this latter phenomenon appears to me to be an *experimentum crucis*,—to prove that a light column of air was suddenly brought over the houses, thus prostrated; and by thus diminishing the pressure on the outside of the house, the elasticity of the air within produced an explosion, prostrating the walls outwards, and carrying off the roof.

An upward force which could carry off a large sycamore many hundred yards, must have been quite adequate to produce this effect, if it could be brought to act instantaneously, or even very suddenly, which, in the present case, the whole description of the phenomena induces me to believe was the fact. Now, the diminution of the weight of the column in the vortex, as estimated above, is more than a pound to the square inch, where the dew-point was assumed at  $71^{\circ}$ , which is a very moderate case, as the dew-point is frequently  $75^{\circ}$ , and sometimes as high as  $80^{\circ}$ , in this climate. Besides, a friend of mine informed me, that in a violent storm in Delaware Bay, he observed his barometer at 27 inches, which amounts to a pound and a half diminished pressure on a square inch; and it will appear, hereafter, that the barometer stood as low as 28 inches, near the termination of a spout in the Orkneys. If we take this low estimate, which gives one pound to the square inch, the force on a wall of a house from within, outwards, at the moment the vortex comes over it, supposing it to be 20 feet high, and 30 feet long, would be 46,120 pounds. One-tenth of this force would prostrate an ordinary wall.

Windows, also, have been known to have been burst open outwards, in this country, by a violent and narrow storm, attended with hail, even when the houses were not thrown down; but as this might sometimes occur when an open door might be directed to a horizontal current, it is not adduced here as proof positive that this effect was produced by an upward vortex. Nevertheless, as the same spout which burst out windows, also lifted up, and carried to a great distance, heavy materials, these facts may well be adduced as *favourable* to the theory. In one case, however, which may be considered very strong in favour of the theory, the roof was taken off from a barn, and the grain in the inside carried out at the top, without the walls being thrown down.

In the eighty-eighth volume of the *Journal de Physique*, page 274, is an account of a great many spouts, both by sea and land. One of these, in the south of France, unroofed eighty houses, dispersed through the country the sheaves of corn which it carried out of a barn, broke the doors and win-

dows of a chateau, and tore up the pavement in the middle of a room, without deranging some piles of china ware in it.

No one can doubt that the hail which fell almost immediately after the passage of the spout, was connected in some way with the spout itself. The manner of its connexion is fully explained by the theory. And even the perfect calm which reigned a short distance beyond the borders of the spout, which, in this instance, was very narrow, may easily be imagined from the outspreading of the air above, causing an increased pressure on the barometer, and thus preventing the air, beyond a certain distance, from moving towards the spout at the surface of the earth, and beyond this point, even causing it to move in an opposite direction.

The direction, also, in which the latter spout leaned, may also be accounted for on supposition that the upper part of it reached the current of air which, in higher regions of the atmosphere, is always moving from the south-west to the north-east; for, as soon as it reached that current, its upper part would be blown in that direction, and the spout itself would have to move in that direction with it. Moreover, the spout would be stationary, if it was formed in still air, until its upper part should reach this upper current, which might be twenty or thirty seconds, and this will account for the excavation of the earth under the place where the spout was seen to be formed.

Again, the theory will account for the rebounding of the spout,—that is, of its sometimes reaching the surface of the earth, and sometimes not. For, where the dew-point was very near the temperature of the air, *there* a very slight rarefaction of the air would produce cold enough to cause a condensation of the vapour, and so the vortex, with its condensed vapour, would be seen to reach the earth, and vice versa, where the dew-point should be many degrees below the temperature of the air.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Computations of the Principal Phases of the Solar Eclipse of May 15th, 1836, for several places in the United States.* By SEARS C. WALKER, Esq.

The following computations of the principal phases of the solar eclipse of May 15th, 1836, have been made by E. O. Kendall, and duplicates of several of them by H. Wilson, from formulæ which I have prepared from the elements in the Nautical Almanac, after the method of Mr. Woolhouse. The beginning, greatest obscuration, and end, are given in mean solar time, May 15th, A. M., civil reckoning. I have examined them, and believe them to be correct.

	Beginning.	Greatest Obscuration.	End.	Digits eclipsed on Sun's south limb.	Latitude and Longitude.
Philadelphia,	7h. 3m. 32.8s. 319° 31' 18"	8h. 13m. 26.1s.	9h. 32m. 17.8s. 103° 41' 41"	7° 51' 34"	39° 56' 59"
Baltimore,	6h. 56m. 20.8s. 319° 56' 49"	8h. 5m. 16.4s.	9h. 23m. 1.1s. 103° 6' 19"	7° 45' 18"	5h. 0m. 43.9s.
Washington,	6h. 53m. 51.5s. 319° 53' 14"	8h. 2m. 32.9s.	9h. 20m. 05.1s. 103° 10' 11"	7° 45' 45"	5h. 6m. 31.3s.
Harrisburg,	6h. 57m. 50.0s. 320° 47' 23"	8h. 6m. 27.7s.	9h. 23m. 30.8s. 101° 55' 15"	7° 34' 3"	5h. 8m. 7.2s.
Lancaster, Pa.	6h. 59m. 13.4s. 320° 19' 50"	8h. 8m. 14.6s.	9h. 25m. 54.7s. 102° 34' 54"	7° 40' 29"	5h. 16' 40"
Pittsburgh,	6h. 45m. 48.7s. 322° 55' 1"	7h. 51m. 59.4s.	9h. 5m. 21.5s. 98° 44' 32"	7° 3' 29"	5h. 7m. 20s.
Detroit,	6h. 39m. 31.1s. 325° 49' 8"	7h. 43m. 29.1s.	8h. 52m. 30.1s. 94° 25' 32"	6° 24' 30"	5h. 5m. 22.2s.
Buffalo,	6h. 55m. 59.0s. 323° 47' 54"	8h. 2m. 42.8s.	9h. 16m. 5.5s. 97° 29' 59"	6° 52' 57"	5h. 20m. 32s.
Rochester,	7h. 0m. 39.7s. 323° 21' 14"	8h. 8m. 7.6s.	9h. 22m. 31.4. 98° 10' 21"	6° 59' 30"	5h. 31m. 52s.
Troy,	7h. 15m. 59.6s. 320° 36' 26"	8h. 26m. 31.3s.	9h. 45m. 28.5. 102° 9' 32"	7° 38' 15"	5h. 15m. 40s.
Schenectady,	7h. 15m. 9.7s. 320° 48' 23"	8h. 25m. 30.2s.	9h. 44m. 10.2s. 101° 52' 40"	7° 35' 30"	5h. 11m. 24s.
Princeton,	7h. 6m. 52.4s. 319° 29' 41"	8h. 17m. 6.6s.	9h. 36m. 22.9s. 103° 47' 18"	7° 52' 47"	4h. 42° 48'
Trenton,	7h. 6m. 18.3s. 319° 26' 13"	8h. 16m. 30.7s.	9h. 35m. 46.9s. 103° 52' 6"	7° 53' 31"	4h. 54m. 40"
Haverford, Pa.	7h. 3m. 5.5s. 319° 43' 3"	8h. 14m. 41.4s.	9h. 31m. 24.4s. 103° 27' 56"	7° 49' 17"	4h. 58m. 20s.
Wilmington, Del.	7h. 1m. 49.1s. 319° 32' 1"	8h. 11m. 31.2s.	9h. 30m. 14.9s. 103° 43' 18"	7° 51' 40"	4h. 58m. 36s.
Newcastle, Del.	7h. 1m. 31.2s. 319° 34' 16"	8h. 11m. 9.9s.	9h. 29m. 49.1s. 103° 40' 0"	7° 51' 7"	4h. 58m. 12"
Dover, Del.	7h. 0m. 20.8s. 318° 47' 50"	8h. 10m. 15.1s.	9h. 29m. 11.7s. 104° 13' 45"	7° 56' 30"	5h. 1m. 26.8s.

These phases have been computed from the equations,

$$\begin{aligned}
 \cos a &= 1.11107 - [0.16621] \sin l + [0.00414] \cos l \cos (\lambda - 56^\circ 49'.5) \\
 \cos a' &= 0.95633 - [0.15790] \sin l + [0.02242] \cos l \cos (\lambda - 41^\circ 27'.9) \\
 \cos a'' &= 0.70356 - [0.15000] \sin l + [0.03777] \cos l \cos (\lambda - 23^\circ 38'.2) \\
 t &= 1\text{h. } 57\text{m. } 24.0\text{s.} = + [3.53968] \sin l - [3.82162] \cos l \cos (\lambda + 82^\circ 43'.0) \\
 &\quad - [3.62430] \sin a \\
 t' &= 1\text{h. } 56\text{m. } 10.5\text{s.} = + [3.61296] \sin l - [3.86356] \cos l \cos (\lambda + 98^\circ 46'.5) \\
 t'' &= 1\text{h. } 35\text{m. } 45.1\text{s.} = + [3.68288] \sin l - [3.90746] \cos l \cos (\lambda + 116^\circ 59'.5) \\
 &\quad + [3.72245] \sin a''
 \end{aligned}$$

Where,—

$l$  = the latitude of a place + North — South

$\lambda$  = the longitude from Greenwich + East — West

$(12h. + \lambda) + t$  = the local mean time of beginning, A. M. May 15.

$(12h. + \lambda) + t'$  = the “ “ “ greatest obscuration.

$(12h. + \lambda) + t''$  = the “ “ “ end.

$209^{\circ} 18' 13'' - \omega$  = angle for beginning.

$211^{\circ} 12' 37''$  = position of moon's centre for greatest obscuration.

$212^{\circ} 52' 26'' + \omega''$  = angle for end.

$[4.62355] (1 + \cos \omega')$  = digits eclipsed on sun's south limb.

The above angles of position are reckoned from north to the right, round the circle, as seen in a telescope that inverts.

In these equations,  $\alpha$ ,  $\omega'$ ,  $\omega''$ , for the United States, are to be taken in the second quadrant. The sum of the apparent semi-diameters has been diminished  $5''$ . If this correction for irradiation be rejected, the beginnings will take place 12.1s. earlier, and the ends 15.1s. later, than the times above given. These results agree very nearly with the rigorous computations in the American Almanac, and with the approximate computations in the same, with the single exception of Pittsburg, at which place, the beginning, greatest obscuration, and end, will take place thirteen minutes earlier than the times given in that publication.

*Philadelphia, March, 1836.*

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## Franklin Institute.

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### *Minutes of the Board of Managers.*

At a meeting of the Board of Managers, held at the Hall of the Institute, January 26th, 1836,

Mr. MATTHIAS W. BALDWIN was elected Chairman of the Board; and Messrs. FREDERICK FRALEY, and JOHN C. CRESSON, Curators, for the ensuing year.

And at a meeting of the Board, held February 17th, the Chairman nominated the Standing Committees, agreeably to the by-laws. On motion, Mr. MATTHIAS W. BALDWIN was added to the Committee on Publications, and Mr. JACOB PEIRCE, and Professor HENRY D. ROGERS, to the Committee on the Cabinet of Minerals; when the committees were appointed, as follows:—

### *On the Library.*

Mordecai D. Lewis,  
Isaac Hays, M. D.  
J. Henry Bulkley,

William B. Reed,  
Alexander M'Curg,  
Earl Shinn.

### *On the Cabinet of Models.*

John Agnew,  
John Struthers,  
Joseph S. Walter, Jr.

John C. Cresson,  
Isaac P. Morris,  
Andrew M. Eastwick.

### *On the Cabinet of Minerals.*

Isaiah Lukens,  
Abraham Miller,  
William H. Keating,  
John C. Trautwine,

Samuel Hufty,  
Jacob Peirce,  
Henry D. Rogers.

*On Publications.*

Alex. Dallas Bache,	M. W. Baldwin,
Samuel V. Merrick,	Rufus Tyler,
Isaac Hays, M. D.	John C. Trautwine.

*On Premiums and Exhibitions.*

John C. Cresson,	Isaac B. Garrigues,
Joshua G. Harker,	Alexander M'Clurg,
William H. Keating,	Alexander Ferguson.
Frederick Fraley,	

*On Instruction.*

Frederick Fraley,	Joseph S. Walter, Jr.
Rufus Tyler,	James M. Linnard,
John Wiegand,	Isaac P. Morris.
Mordecai D. Lewis,	

*On the Monthly Meetings.*

Isaac Hays, M. D.	Benjamin Reeves,
Alex. Dallas Bache,	John C. Cresson,
Rufus Tyler,	A. M. Eastwick.

*Managers of the Sinking Fund.*

Samuel V. Merrick,  
Frederick Fraley,  
Alexander Ferguson.

*Auditors.*

Isaac B. Garrigues,  
Joshua G. Harker.

(Extract from the minutes.)

M. W. BALDWIN, *Chairman.*

WILLIAM HAMILTON, *Actuary.*

COMMITTEE ON SCIENCE AND THE ARTS.

*Report on Mr. A. C. Jones' Spark Arrester.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, an apparatus for stopping the sparks from the flues of locomotive engines, invented by Mr. Alfred C. Jones, of Portsmouth, Virginia,  
REPORT:—

That it has for some time been considered a desideratum to devise a plan by which the sparks escaping from the chimney, or smoke pipe, of a locomotive engine, may be arrested, so as to ensure both the comfort of passengers, and the safety of goods, transported on rail-roads. The rapid extension of this mode of conveyance, is every day rendering this object of increased importance. Judging from the certificates of engineers and others, exhibited by Mr. Jones, it may be inferred that he has been more successful in relation to it, than preceding inventors.

The principal peculiarities of Mr. Jones' invention, are the following.

1. A projection, and funnel shaped opening, in the front part of the wire gauze, which surmounts the smoke pipe. This opening is for the purpose of admitting the external air to mix with the escaping smoke and steam, and is supposed to have the double effect of cooling and condensing the smoke and steam, so that it will not burn and destroy the wire gauze, and of pro-

ducing a horizontal, or backward, current of air, which throws the sparks into the receptacle hereafter described.

2. A peculiar shape in the wire gauze cap, extending a considerable distance backward, over or beyond the back of the top of the smoke pipe, which affords a space for the sparks to be thrown down into the receptacle hereafter described, the shape of the back part of the cap, or wire gauze, being such that the sparks do not strike it perpendicularly, but obliquely to its surface, and thus are thrown down, instead of passing through the apertures.

3. A receptacle for sparks, back of the top of the smoke pipe, and under the back part of the gauze cap, at the lower part of which receptacle is a pipe, extending downward into the smoke chamber at the end of the boiler, and below the part immediately connected with the boiler. Through this pipe, the sparks pass, and fall into the bottom of the smoke chamber. It is supposed by Mr. Jones, that the impetus of the steam, escaping from the engine, through the smoke pipe, produces a partial vacuum in the bottom of the smoke chamber, and causes a portion of air to rush down the said pipe, which makes the sparks the more readily descend, to a place where they are beyond the influence of the escaping current of smoke and steam, there to be consumed.

4. The gauze cap is made with hinge joints, so as to be thrown over backward, when the engine is not under way. This contrivance serves the double purpose of preventing the gauze from being clogged with lampblack, by the thick smoke escaping before the starting of the engine, and of facilitating the cleansing of the gauze, by a brush applied to its inner surface, where the smoke and lampblack condenses.

It is the opinion of the committee, that each of the foregoing features is productive of advantage. Hence, they are of opinion that Mr. Jones' apparatus is among the best that has been devised; an opinion which is confirmed by the respectable testimony which has been adduced.

There is a suitable apparatus for arresting the sparks when the engine is going backward, which it is deemed unnecessary here to describe.

By order of the committee.

January 14, 1836.

WILLIAM HAMILTON, *Actuary.*

### *Report on Mr. L. V. Badger's Hot Air Forge.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, the Hot Air Forge, invented by Mr. L. V. Badger, of Portsmouth, New Hampshire, REPORT:—

That this forge consists of a hollow cast-iron hearth and back, divided by a number of air-tight partitions, so as to form, for the passage of the blast, one continuous square channel; this channel traverses both the back and the hearth. The air from the bellows, entering by the back, must flow between the partitions, doubling backwards and forwards, and passing the elbows between the back and hearth, until it reaches the tuyere, after nine changes in its direction. There are two tuyere holes, one at the corner of the back and hearth, the other considerably higher up in the back. The air from the lower tuyere flows out, through twenty small perforations, in a convex, hollow, false hearth, which is retained between two guides, and can be removed for the purpose of cleaning it.

The arrangement by which the air is made to traverse the hollow back and hearth, in order to cause it to enter the fire at an increased tempera-

ture, is neat and simple, but, in the opinion of the committee, ineffectual to produce the object. The amount of heated surface past which the air must flow, is so small, and the temperature itself of much of the back and hearth so low, as not to justify the anticipation of any material improvement in the temperature of the blast entering the fire. But any increase of temperature thus procured, will be more than counterbalanced, it is believed, by the important reduction in the force and velocity of the air, caused by the numerous turns and angles which it must surmount in reaching the tuyere. It is apprehended that the loss of blast from this source, is the radical defect of the proposed forge, while no commensurate gain can be exhibited from the augmentation of temperature.

There appears, also, to be an evil incident to the construction of the false hearth, namely, that the slag will be apt to choke up the perforations, more especially at each time that the hearth is permitted to chill.

By order of the committee.

February 11, 1836.

WILLIAM HAMILTON, *Actuary.*

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## Mechanics' Register.

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### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1835.

*With Remarks and Exemplifications by the Editor.*

1. For a *Lever Press*; Jonathan Payne, Russelville, Logan county, Kentucky, Sept. 9.

This lever press, it appears, has been the subject of an arbitration under the ninth section of the patent law of February, 1793, relating to interfering applications, which terminated in favour of the above named patentee. The construction of the press is pretty clearly made known in the specification, but no claim is there made to any part of it. It is intended for cotton, hay, tobacco, &c. &c. and is constructed as follows. A stout sill, from 30 to 50 feet in length has, rising from the middle of it, two upright pieces of timber 10 feet high, which serve to sustain a lever, or beam, between them of the same length with the sill, and measuring 12 by 18 inches. A stout pin, serving as a fulcrum passes through the upright cheek pieces, and through the beam. Either end of this beam may be drawn down by means of a rack and wheel work, the latter being sustained by the sill, and the former depending from the lever. A pinion, probably of 4 or 5 inches in diameter, turned by a winch, gears into a wheel of 7 feet diameter, having a pinion on its axle of 6 or 7 inches diameter, which acts upon the rack.

No directions are given for using this press, but as only one end of the beam can be employed at a time, the rack and gearing must at one end be used to raise, and at the other to depress the beam, between which and the sill the pressing must, necessarily, be effected.

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2. For a *Churning and Washing Machine*; Thomas Ling, Winthrop, Kennebec county, Maine, September 9.

This is a swinging, or pendulum churn, which really has some novelty about it, and even in this fact alone, there is something cheering, as originality has long been a rare element in churns and washing machines.

The churn is a round tub suspended vertically within a frame, so that it

can swing like a pendulum. A vertical shaft within the tub carries dashers, as is the case in many other churns. To cause the dashers to operate, the shaft projects above the tub, and a string, or cord, passed once or twice round it, the two ends of the string being attached to opposite sides of the frame; on vibrating the tub, the string operates like a drill bow, as will be readily perceived. The claim is to "the modification and combination of the swing or pendulum churn and the dasher, for churning and washing."

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3. For a machine for *Washing Clothes and Fulling Cloths*; Orrin D. Wade, China, Genessee county, New York; an alien who has resided two years in the United States. September 9.

The clothes are to be put into a box, or trough, through the lid of which there passes a row of upright shafts having flat blocks of wood on their lower ends, which blocks nearly touch each other. A row of horizontal levers, hung upon fulcra, and acted upon by lifters on a revolving cylinder, cause the shafts and their blocks to rise alternately, whilst springs above the levers force them down. This constitutes the whole apparatus, to which no claim is made.

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4. For a machine for *Purifying Potters' Clay*; Adam Weber, Womelsdorf, Berks county, Pennsylvania, September 9.

A cylinder is to be made of wood or metal, the bottom of which is to consist of a sieve through which the tempered clay is to be pressed by means of a piston fitting the cylinder, and forced down by a lever. The machine is claimed, generally, as operating upon the principle, and applied to the purpose indicated.

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5. For a *Revolving Platform for Rail Road*; John Tustin, city of Philadelphia, September 9.

We believe that the mode of construction here proposed has not been made the subject of a patent, but recollect its being proposed, and an opinion given, that the plan would not be approved in practice.

A circular channel is to be made in the bed upon which the platform is to rest, which channel is to be adapted to the reception of round balls, like cannon balls. The revolving platform is to be similarly grooved on its lower side, and placed upon the bed with a sufficient number of balls to be nearly in contact with each other; as a safeguard, there is to be a centre pin.

With a heavy weight upon such a platform there will be much friction, the balls as they revolve passing over very unequal spaces on their touching parts; they will also be apt to overtake each other, and thus increase the evil.

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6. For a machine for *Shelling Corn*; Elijah Morse, Knox county, Tennessee, September 9.

A roller of cast iron is to revolve horizontally, and upon it there are to be rows of teeth which pass between others on the frame. The feeding, as we suppose, is to be effected by placing the ears upon a concave, hinged cover; whence they are to roll, or be forced, against the revolving shaft; a winch occupies one end of this shaft, and a fly wheel the other. The description is very imperfect, and the drawing, although well executed, must certainly show the teeth of the machine, and some other parts, incorrectly. The claim is to "the application of the roller, and the general construction of the whole machine."

7. For the *Application of Hydraulic Cement, &c.*; Obadiah Parker, city of New York, September 9.

This is an *application patent*, like most of, or nearly all, those obtained for the use of cement. By an application patent, we mean one which might be taken for applying a plaster of some approved salve to the head, another being taken for applying it to the shoulder, and others for all the various divisions and subdivisions of the superficies of the corporeal system. In the present instance are enumerated, "house and store cellars, vaults, small wood-cellars, vegetable cellars, cellars under side walks in cities, vaults in cemeteries, and vaults for milk, and garden cellars; the construction of walls, floors, and roofs of buildings, and walls for enclosure; the construction of locks and guards for canals; the construction of sinks for kitchens, and other purposes;" "which has not been known or used." Indeed! there is novelty in this information, and this, we are well convinced, is the only place in which we shall find it, although eighteen pages are occupied by the specification of these applications, and the claim thereto.

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8. For *Making Artificial Stone, or Marble*; Obadiah Parker, city of New York, September 9.

Pulverized granite, or pulverized marble is to be brought to a proper consistence for moulding into the required form in combination with water lime. This constitutes the *INVENTION*.

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9. For the *Formation of Artificial Stone and Marble for Architectural Purposes*; Obadiah Parker, city of New York, September 9.

We have again about a dozen pages devoted to the mode of forming various ornamental and useful articles, pavements, &c. &c. by modes analogous to those described in the preceding specifications, and having, consequently, the same claim to novelty, or rather to antiquity. Should the patentee think himself aggrieved by the foregoing remarks, a thing which we do not anticipate, we will offer him a reference to a gentleman in New York, who can tell him much more about the combinations of water lime, and the formation of artificial stone than he now knows; and will give him ample proof that our animadversions, or rather intimations, are founded in perfect truth.

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10. For a *Water Wheel*; Jehiel W. Dart, and Stephen Wood, Truxton, Cortland county, New York, September 9.

This is a kind of re-action apparatus, in which two wheels differently constructed are to be placed one close above the other on the same vertical shaft; the first of these wheels has four floats which revolve in a circular drum through the side of which the water enters tangentially to the circle, and strikes the floats; after performing its labour there, it escapes through a centre hole in a horizontal partition, and enters the ordinary reaction wheel, passing through its curved channels, and escaping at its periphery.

The claim is to "the increase of power which is obtained in the above arrangement of the central discharger, or whirlpool wheel, and the reaction wheel." This is rather an inverted claim, being to the end instead of to the means, but this in the present case is a thing of little consequence.

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11. For an improvement in the *Composition and Manufacture of Gum Elastic Cement*; Charles Goodyear, New Haven, Connecticut, September 9.

After dissolving the gum by means of spirits of turpentine, using two quarts of the spirits to one pound of the gum, magnesia is to be combined with it in the following way. One pound of magnesia is to be sifted through a fine sieve, into about two quarts of alcohol, with which it is to be well incorporated; a proper portion of the magnesia and alcohol is then to be mixed intimately with the dissolved gum, the quantity varying for different purposes, but being generally, in the proportion of six ounces of magnesia to the pound of gum. When applied between cloths, or to vessels to be filled with air, four ounces will suffice. When used to cover cloth on one side, eight ounces is preferred. If the whiter parts of the caoutchouc be taken, a solution will be obtained nearly colourless, and capable of receiving any desired tint.

We are not told that the magnesia is to be calcined, but being used as an absorbent and dryer, we suppose this to be case. This compound, it is said, dries very readily, is not tackey, and has the usual unpleasant odour corrected. The claim is to the application of magnesia.

We have been informed by a manufacturer that he has used magnesia with the solution, repeatedly; whether before it was used by the present patentee, or under such circumstances as to interfere with his patent, we do not know.

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12. For a *Rotary Steam Engine*; John Bennock, Orono, Penobscot county, Maine, September 0.

A circular channel for a piston to revolve in is formed by bolting together two metallic rims, each of which contains one half of the channel turned perfectly true. These two parts are connected by bolts through flanches outside of the circular rim only, those on the inside not being in contact, but so far apart as to allow the flat rim of an interior wheel to be interposed between them; this wheel revolves on an axis passing through the centre of the circular channel, above mentioned, its periphery just reaching it, and having attached to it the revolving piston. Metal rings, inserted in grooves, and borne up by screws, are to be employed as packing against the sides of the interior wheel. A sliding valve, contained in a valve box, is withdrawn to allow the piston to pass, being acted upon by cams on the main shaft. There are, of course, proper openings for the introduction and escape of steam.

The machine is to be doubled, there being two circular cavities with their pistons, and other appendages, but having their valves in reversed directions, that the full action of the steam may always be upon one of them; the same main shaft is to carry both of the piston wheels. The claims made are to the using of two circular channels; the arrangement of the valves and pistons; the metal rings for packing, contained within grooves in the inner flanches, and the mode of pressing them up.

There is nothing new in this engine, either in the general construction, or in the particular points claimed. We could refer to engines essentially the same, in several published works treating on steam engines; but the worst feature of the affair is that neither of those which it resembles have answered in practice, whilst that now presented to us, does not appear to contain any redeeming point. It will be much more difficult to make than the ordinary engine, more difficult also to keep in order, and it will require considerably more steam to perform the same quantity of work.

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13. For an improved *Platform Balance*; Jesse Marden, city of Baltimore, September 9.

The whole claim made in this case is to "the manner of constructing the platform so as to project downwards for the purposes specified." "Now my improvement consists in forming a downward projection from the side pieces of the platform, by means of rings, or links, and staples, from the inner prongs of the fulcrum, by which the platform hangs perfectly free, and will play in any direction, as if it hung on chains or ropes, always finding its centre of gravity."

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14. For a mode of *Relieving the Shock in the Stopping of Rail Road Cars*; Charles Davenport, Cambridge, Middlesex county, Massachusetts, September 9.

Those who are well acquainted with the improvement in rail road cars, are aware that what has been called a buffing apparatus has been used to take off the shock occasioned by their coming into contact; the patent above named is obtained for a different mode of accomplishing this object, and also of affording a similar relief in starting. Instead of the continuous centre pole, by which the cars are connected, which receives the shock in stopping, and which takes the place of a perch in common carriages, there is a sliding box that projects out in the same manner, and is at its inner end connected to elliptical springs, like those used in carriages, placed transversely with the pole, and which are so fixed as to have the requisite play in either direction. Instead of these it is proposed to use spiral springs, fixed in the manner described in the specification. The claim is to the application of such springs.

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15. For an improvement in the *Dead Spindle*, used in spinning cotton. Henry G. Davis, Northborough, Worcester county, Massachusetts, September 9.

The following quotation will afford a general idea of the nature of the proposed improvement.

"My design being to relieve the spindle from the friction of the fly whirl, and the tremulous motion incident thereto, I make the whirl, and consequently the flyers, play upon a tube, called the friction axis, through which the spindle passes, instead of playing upon the spindle itself; as is now done in the spinning frames in use, and not of my invention. To accomplish this the tubes must be stationary, and of sufficient strength to sustain and keep regular and steady the motion of the flyers. I have attained this end by one casting of iron, which constitutes the tube, and affords the means of fastening it to the spinning bar, so called in spinning frames, in such way that the spindle passes through it, and when the whirl of the flyers is brought to its place it fits to the tube, and turns upon it as a perpendicular axis, instead of turning upon the spindle; the tube being a shell interposed between the spindle and the whirl.

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16. For a *Safety Hook, for detaching Tow Lines on Canals, &c.* Gotlieb Schultz, city of Philadelphia.

This is merely a spring catch that may be opened by drawing upon a cord which disengages it, and allows the tow line to go clear. A similar contrivance it is proposed to affix to the swingle tree of a carriage. There is no claim, and but little room for one.

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17. For an improvement in *Rail Way Cars*; Anthony Sherman, city of Philadelphia, September 9.

The fore and hind wheels are to have separate frames, but they are to be connected by jointed, transverse coupling rods, in order to enable them to turn easily, and to adapt themselves to the curvature of the road. The axles are each to be divided in the middle, to allow an independent motion to each wheel, the axles are also to be enclosed within a safety tube, running along it, which will support it in case of breaking. The transverse rods, and the divided axles, have so often come under our notice that we have nothing further to say about them. They however, form prominent parts of the present claim.

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18. For *Eradicating Corns*; William Davis, Williamsburg, James City county, Virginia, September 9.

Diluted nitric acid is to be applied to the corns to soften them, and they are to be rubbed down with pumice stone; that is all. Nitric acid has often been applied to corns, and they have been rubbed down by files, or by emery sticks, made for the purpose; we apprehend, therefore, that those who have corns may still use the indicated means of cure.

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19. For an improvement in the *Coffee and Corn Mill*; Elijah Morse, and Caleb Putnam, Knoxville, Tennessee, September 9.

Nominal *improvements* are so easily made that it requires no talent whatever to be the author of them, and such is that which forms the subject of the present patent. The mill in which the pretended improvement is made, is the common cast iron mill with a conical shell and nut, in its unaltered state, excepting only that the patentees "claim as their own invention, and not previously known in the above machine, that the furrows in their mill run straight through, and not spiral, as in all other mills." It does not require two grains of mechanical knowledge to enable a person to decide that this change deteriorates instead of improves the mill; nor is it necessary to have dipped deeply into the logic of Aristotle, or of Watts, to arrive at the conclusion that it requires one and one to make two, yet in the case before us we are to admit that the inventive genius of two individuals might be put into requisition to devise one set of straight furrows.

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20. For a *Bedstead for the Sick*; Nathaniel Richardson, Boston, Massachusetts, September 9.

It would be a sheer waste of time to detain our readers with a particular description of this contrivance, which is intended only to elevate the upper or lower half of the frame and sacking bottom of a bedstead, by means of a windlass and cord. The mode of doing it is no improvement upon others, and the end obtained does not differ in the slightest degree from that often accomplished, and attainable by any mechanic in his own way. "The combination and arrangement of the parts" forms the stereotyped claim.

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21. For a *Saw Set*; Lewis Barmore, Hanover, Chataque county, New York, September 9.

The principal part of the specification of this patent consists in the exact measurement of the respective parts, and other matters of no moment. The setting is to be effected by placing the teeth of the saw upon a small anvil, and striking with a hammer, the handle of which passes through a shaft turning on gudgeons in uprights, the hammer being raised by the revolution of a piece of wire, bent crank fashion. The saw is to be sustained upon

a rest, and the points of the teeth are to bear against a metallic roller. The claims are to "the application of the crank to the hammer handle; the rollers to guide the teeth of the saw across the anvil, and the rest, block, and gauge, and their advantages," which latter appear to us to be few in number, as there are many saw sets in the Patent office which we should prefer to this last improvement.

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22. For *Stamps for Post Offices*; Benjamin Chambers, city of Washington, September 9.

These stamps are to have a fillet round the outer edge of the face, which fillet is cut, or left, on the solid metal. It surrounds, and is intended to protect, the letters which designate the office. The claim made is "the manner in which I construct the ledge, or projection on the outside circumference of the face of the block, being cut out in relief from the solid body of the cylindrical block."

We have seen such fillets, or ledges, cut out of solid blocks both of wood and metal, in use long before the obtaining of this patent.

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23. For *Supplying and Regulating the Draught of Air to Fire Places*; Robert Mayo, city of Washington, September 9.

Pipes, or tubes, of tin, or other material, which may be from one and a half to three inches in diameter, are to lead from the lower part of a building, up the outer walls, their upper ends opening under the grate or fire place. Such pipes may be added to buildings already erected; but in the erection of new ones it is proposed to form these ascending air channels within the thickness of the walls, their lower ends opening to the external air, and their inner to the fire place. Valves to regulate the quantity of air admitted, may be constructed of any suitable form.


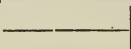
The claims made are "*First.* The arrangement, combination of parts, and adaptation of the air pipes, or tubes, to ascend the outer walls or chimneys of buildings, or apartments, and penetrate the same contiguous to fire places. *Second.* I claim the construction of air channels or flues in the masonry of chimneys, or the walls of buildings, to ascend from a lower stratum of atmosphere and terminate near to, or in, the fire places."

With the exception of extending the tubes to the lower part of a building, it will not be pretended that there is any novelty in this contrivance, the practice of admitting air from without to feed fires, being old and common; but even the ascending tubes themselves are not new, they having been frequently recommended and applied to the supply of fires for the purpose of ventilating cellars, and other lower apartments; it may be said, however, in the present case, that this is not their object, that object being merely the supply of the fire; without inquiring into the validity of this allegation, it is proper to ask what are the advantages of these descending pipes, and we believe that this is a question which cannot be satisfactorily answered. The patentee says that we shall "thereby create a constant current through the tube, or pipe, of a strength proportionate to the height of the pipe, or the greater weight of the medium of atmosphere at the lower extremity, or inlet, than that at its upper extremity, or outlet; which takes place upon the same principle of pneumatic or atmospheric pressure, which forces water in a tube, or well, to rise to the height indicated by the known weight of the atmosphere: and this principle is equally applicable, of course, to the air channels, or flues, constructed in the masonry."

The foregoing may pass with the illiterate for good reasoning, but it is altogether false and unfounded. The pressure at the opening of the tube within the room will not be altered by the extra height of the atmosphere above the lower opening, the column within the tube being a perfect balance to this; the whole trouble and expense of the tubes may, therefore, be saved, together with the cost of a patent right to do that which is in itself altogether useless.

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24. For a *Saw Mill Gauge*; William A. Needham, Brimfield, Hampden county, Massachusetts, September 9.

This appears to be a very imperfect affair, when compared with many other devices for setting or gauging saw logs. A bar of iron is to be bent twice at right angles, thus,  its ends being attached by hinge joints to the head block; upon the top bar there is to be a slide, which may be secured by screws, and which is to be graduated into inches and parts. The end of this bar towards the log has a piece attached to it, thus,  which piece is to bear against the log, and to keep it upright. The claim is to "the arrangement of the parts described, to cause a log to be sawed into any required thickness marked upon the graduated edge of the slide."

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25. For a *Cooking Stove*; John Whiting, of Boston, and John Mears, of Dorchester, Norfolk county, Massachusetts, September 9.

The main, or only, novelty in this cooking stove, consists, like that of most others, in the particular arrangement of the respective parts, as devised by the patentees. The claim is to "the construction of such stoves, as aforesaid, and the several parts thereof, not separately, but in combination for the purposes aforesaid; and also the construction of stoves so that the hot air may pass first over, then down by the side of, and then under, the oven, and then between the oven, and the furnace, in manner aforesaid, and for purposes aforesaid. The construction of the oven and furnace may be somewhat varied, at discretion, and the side door for roasting may be dispensed with, if thought advisable; but the construction above mentioned is deemed most convenient, in all cases." We cannot attempt a description of the particular arrangement, which is well shown in the drawing, referred to throughout in the specification.

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26. For a *Coopers' Stock, Howel, and Croes*; Melancthon Sutton, Penfield, Monroe county, New York, September 9.

In this invention, the work heretofore requiring the use of two instruments, is to be performed by one. A very particular description of the tool is furnished, and explained by reference to the drawings, which show the peculiar form given to the cutting iron. The claim is to "the peculiar construction of the edge and angles of the cutting instrument, by which it supersedes the necessity of a separate howeling iron, and performs the work in less time. The moulding of the faced edge of the stock face, to conform to the cutting angles of said instrument; and the sliding gauge, as described, and delineated in the drawing."

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27. For a *Washing Machine*; James Lombard, Readfield, Kennebec county, Maine, September 9.

The trough of this machine is a concave semi-cylinder, closed at the ends,

and fluted along the semicircular part. The *rubber*, which is to act upon the clothes, is also a semi-cylinder, which passes into the trough, and is suspended by an axis at, or near, its centre. This rubber is either fluted, or covered with fluted rollers, passing from end to end on its curved surface. It is so hung, by means of a strap, or chain, as that it may recede from the trough, when too great a quantity of clothes may be between them, and also to admit of its continued pressure upon them. The rubber is to be made to vibrate by means of a handle. The claims are to "the form and application of the rubber, or interior cylinder. The mode of suspending and operating the rubber, and the application of the strap, or chain, whereby the pressure is regulated, and the rubber allowed to yield."

28. For an improvement in the *Saw Mill*; Linus Yale, Utica, Oneida county, New York, September 11.

Upon the head block there is to be a plate of cast-iron, about three feet in length, which slides between grooves, or ledges, on a cast-iron bed, that is fastened to the block. A bar of iron, which may be an inch and a half square, is to be placed upon the slide, along that edge of it which is farthest from the log; by means of pins and holes, properly constructed, it may be placed firmly upon the slide, with either of its sides uppermost, and these four sides are divided and notched to suit four different thicknesses of stuff, the notches serving for a setting pall to fall into, which is acted on by a lever, which lever, when raised by the hand, sets the log. A similar slide, and its appurtenances, are affixed to the tail block, but here it is rendered self-setting by an apparatus, not very clearly described, and for the study of which we cannot afford much time. A particular construction of the dog is also described, but so obscurely that we know little, or nothing, about it, although it forms one of the matters claimed. Neither the use of the lever, nor of the slide containing the dog and bar, is claimed, but, "*first*. The dogs swinging upon a vertical shaft, as described. *Second*. The construction and use of the notched bar, as set forth. *Third*. The construction and use of the pointed, or setting, arm, as set forth. *Fourth*. The manner in which I construct the inclined plane, as set forth. *Fifth*. The manner of casting the plates and slides together."

The third and fourth claims refer to the self-setting part; the fifth at least, it might have been better to have omitted.

29. For a *Machine for Breaking and Cultivating Sward Ground*; Guy Gray, Industry, Somerset county, Maine, September 18.

A square frame is made to contain a roller, like that used for rolling ground, and a tongue is attached to the frame to draw it by. The roller, as described, is four feet long, and is set with teeth in twelve rows, containing, alternately, five and six in a row; the teeth, which are pointed, are seven inches long, but curved so as not to project more than six inches from the roller. There are teeth, also, on the back rail of the frame, so set as to allow the roller to pass between them. The patentee says, that when this is "drawn over the closest sward land, it breaks it more thoroughly than any other machine known to him, so that the ground may be afterwards ploughed with less than half the strength of team otherwise required, whilst it is left in a much better state for cultivation."

There is not any claim made; the whole must, therefore, be considered as new, or the patent cannot be sustained.

30. For a *Loom for Weaving the Cloth for Stocks*; Conrad Kile, Erie, Erie county, Pennsylvania, September 18.

The frame, warp, and cloth beams, &c., are placed in the usual manner, the improvement consisting "in the form, or mode, of constructing them, and is grounded on the following requisite, to make the stock set closely to the neck, and accommodate itself to the shape, viz: that the selvage should be much longer than the centre of the cloth, so that, while the centre of the stock fits the neck closely, the selvage, both at top and bottom, is so loose as to yield easily to the motion of the chin, after the manner generally effected by inserting pieces of an angular shape around the top and bottom. This object of increasing the length of the selvage, I effect by means of the shape I give the beams above mentioned on their circumference, for, instead of their being straight from one end to the other, I form them concave, so proportioned that the girth of the centre of the beam is about one-third less than that of each end."

The particular arrangements necessary, or adopted, in completing the plan, are described at considerable length, and a claim is made to "the concave shape given to all the beams, and to the reed; to the manner of making the lower semicircular bar of the reed; and the manner of joining the uprights of the reed, by means of arms, to the axis of the straining beam."

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31. For a *Tailors' Measuring Apparatus*; John S. Rockafellow, Flemington, Huntingdon county, New Jersey, September 18.

The claim made is to "an improvement on D. Williams' patent, by the construction of a scale equal in length to the entire circumference of the human body, and having the tape of an entire length, and the movable slide and upright to secure a correct measurement for the cutting of garments."

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32. For an improvement in *Beds, Cots, and Hammocks*; William I. and Alfred E. Lyman, Easthampton, Hampshire county, Massachusetts, September 18.

The specification of this patent is more sentimental in its commendatory, than clear in its descriptive, part. It seems, however, that conical, spiral springs of wire, are to be interposed between the rails of a bedstead, and a frame above it, over which a covering of cloth, leather, &c., is to be stretched. For cots, &c., the fixtures must be adapted to them. In warm weather, a sheet only, and, at other seasons, a covering adapted thereto, will, we are told, "render this bed a great comfort to the sick, the weary, and the aged, and a great exciter to 'nature's sweet restorer, balmy sleep.'" By the action and reaction of the springs, support is afforded to the inequalities of the human frame in equal measures, so that muscular action is in a sense suspended, and a quiet repose given to the whole system."

The patentees "claim as their own invention and improvement, the application of metallic conical spiral springs, as a support in the fabrication of beds, cots, or hammocks, in the manner herein described."

How many patents for the application of spiral springs we have seen recorded, we cannot tell, but they are not few. We, however, recollect one from the same county with the foregoing, dated August 25th, 1831, and noticed at p. 128, vol. ix., which, uninviting as we thought it, appeared to offer more comfort than the one under consideration.

33. For a *Plough for Cultivating Corn and Potatoes*; Peter Stahl, and John Diffenbacher, Turbut township, Northumberland county, Pennsylvania, September 18.

This instrument is made in the form of what is commonly called a cultivator, and is furnished with six shares, affixed to standards twenty inches in length, for the purpose of mounting the beams high up above the ground. For the particular form of the shares, the model is, incorrectly, referred to. The following is the claim.

"The shares, or mould-boards, which are each cast in one piece, and forming a coulter, share, and mould-board. The high standards, which carry the plough beams so far above the corn, or potatoes, as not to break it down so long as it needs cultivating. The placing these in such a manner as to plough, or cultivate, both sides of a single row of corn, or potatoes, at one and the same time of going over the same."

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34. For a *Wool and Flax Brusher*; William W. Calvert, Lowell, Middlesex county, Massachusetts, September 18.

"The principle by which this is distinguished from all other inventions, is the brushing of wool, or flax, by a bristle, or wire, brush, into teeth set on a cylinder, or otherwise, as may be convenient. And also the combination of the parts of the universal swiper, for which I claim a patent." The object in view is the separating the long and short fibres from each other. The machine is well represented in the drawings, and clearly described; without the former, however, we should fail in an attempt at the latter. We think that much ingenuity and skill are manifested in the mode adopted for carrying out the conceptions of the patentee, but we are unable to offer any opinion of the probable success of the plan, as it is, in the present instance especially, a question of experience.

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35. For *Printing and Dying Woolen Cloth*; William Duncan, Bellville, Essex county, New Jersey; an alien, who has resided two years in the United States; September 18.

If the person who has obtained this patent was employed in the woolen business in Great Britain, before his emigration to this country, we should not be able, with the utmost stretch of charity, to believe that he was unacquainted with the fact that the process he describes was generally known, and frequently used there. That we may not err in giving the process for which he obtains a patent, we will quote the precise words of the patentee himself.

"In order to preserve the native, or any other colour, for the purpose of ornaments in the printed article, from receiving the general, or ground colouring, which is given to it in dyeing the same, the ornamental figures are to be tied in knots, in such manner and form as the artist may think proper, by winding round them hemp, or thread, of any description, so as to resist the general colouring matter from penetrating into those figures."

We have known the process for more than half a century; among our earliest recollections are woolen garters, with mottoes on them, made by pressing against the strip of cloth, a mould, with letters cut on it, and thereby protecting the parts pressed in the process of dyeing. At the ends of these mottoes, and at other parts, were the flower-like ornaments made, in the way above described. But, apart from this, there are few dealers in cloth, anywhere, who are not well acquainted with this process, as it is

common as a test mark on the corners of pieces of cloth, to show that the colour given has been produced at two operations. Who has not observed these stars, or rosettes?

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36. For a *Machine for Planting Cotton*; Robert S. Goodman, Ballsville, Powhatan county, Virginia, September 18.

This is one of those classes of machines, the individuals of which can scarcely fail of exhibiting a strong resemblance to each other. They run upon wheels, which are fixed on a revolving shaft, or axle; they carry a hopper, into which the seed is put, and which falls through an aperture regulated by the revolving axle. There is a share in front of the machine, to open a furrow, and a scraper behind, to cover the seed. These are the general elements, which are common to all, and are common property; what is left, therefore, to ingenuity, or fancy, is to devise those minor arrangements upon which the more or less perfect action of the machine is dependent, and which have usually too little of originality, or skill, to render it worth while to follow them out, and such we think the case in the present instance. The claims are to "the manner of using the wheel at the perforation at the bottom of the hopper. The revolving shaft, with the pin, or pins, and conductors, attached to it, to be set in motion in the manner described."

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37. For a *Machine for Shelling Corn*; James S. Harris, Poultney, Rutland county, Vermont, September 18.

We apprehend that this will prove to be one of the least valuable of all the corn shelling machines, from its being inconvenient and laborious to operate with, whilst it will not be recommended by its efficiency. It consists of a fixed rubbing board, set with teeth, or otherwise furnished with projecting points, and a movable rubbing board, to be worked up and down by a lever, which is moved by the right, whilst the feeding is to be performed by the left hand. No other provisions are spoken of, nor is any claim made.

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38. For a machine for *Setting Boxes in Hubs*; Edward Badlam, Jr., Chester, Windsor county, Vermont, September 18.

The hub is to be fixed on a frame, being adjusted by screws, so that it shall be properly centred. A shaft, fitted into collars, and turned by a winch, carries the cutters which are to let in the box, which cutters are made adjustable, in order to adapt them to the required size. The claim is to "the arrangement of the slides, dies, screws, and scales, for the purpose of adapting the machine to all sizes of hubs, and to enable the workman to set the hub in the centre of the frame."

There are several patented machines for the same purpose, arranged in a very similar way, and possessing all the virtues of the foregoing.

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39. For *Propelling Time-pieces by the Expansion and Contraction of Atmospheric Air*; Andrew Morse, Jr., Bloomfield, Somerset county, Maine, September 18.

How many such machines as that here patented have been made, it would be impossible to tell, as they are calculated merely to satisfy the curiosity of their contrivers, and destined to final repose in the lumber room. An instrument very similar to that before us, is noticed at p. 126, vol. v. of

this Journal, and some remarks upon the application of the principle of expansion and contraction by change of temperature, may be found in vol. 2. p. 326. The air which is to operate, is to be contained in a cylindrical vessel, within which there is to be a second cylinder, open at top, but closed at the bottom by a sheet of India rubber, or other flexible, air-tight material. As the air alters in its dimension by heat, it is to raise and lower a piston, working loosely in the inner cylinder, and resting on the India rubber; a rod from this piston turns ratchet wheels, and winds the clock. The claim is to "the before described machine for winding up time-pieces, with the arrangement and adaptation of its several parts." Were the thing of any value, it might be a matter for regret that the description and claim were not less vulnerable than they are; but we think them as good as the invention, and do not anticipate the validity of the contrivance being made a question in court.

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40. For a *Machine for Dressing Hoops*; B. Kimball, A. Pevey, and F. Spalding, Petersborough, Hillsborough county, New Hampshire, September 18.

A wheel furnished with cutters on its face, near to its periphery, is made to revolve by means of a mandrel, like that of a lathe. A gauge stands in front of the cutters, having a roller, against which the outside of the split bears; this gauge is capable of being made to recede, by means of a lever, so as to allow the necessary increase of thickness in case of knots, &c. The following is the claim. After stating the various modes of arrangement which may be adopted, the patentees say: "We do not, therefore, claim the individual parts of this machine, as they have all been used under other combinations, and for various other purposes; but what we do claim as our invention, is the construction of an instrument for dressing hoops, made and operating, substantially, in the manner herein set forth; having a revolving cutter wheel, a shifting gauge, and the auxiliary appendages which give to it that character by which it is distinguished from other machines for the same purpose."

This machine has, we are informed, been found of very great value in its application to the purpose for which it was constructed.

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41. For a *Cradling and Mowing Machine*; Edward Badlam, Jr., Chester, Windsor county, Vermont, September 18.

By means of a face cog wheel on the inside of one of the wheels upon which the machine runs, motion is given to a horizontal shaft, the opposite end of which gears into a bevelled pinion on a vertical shaft, which sustains scythes, revolving horizontally. Small wheels on the underside of the fixtures of these scythes, run upon the ground, and serve to raise them over knolls, whilst springs above them keep them in their places; the grass, or grain, is received upon fingers, which conduct to a rack.

The claim is to "the springs, with the fixtures for enabling the scythes to pass over small knolls; the fingers and the rack, for the purpose of catching and laying the grass and grain, after being cut by the scythes."

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42. For machinery for *Cutting and Collecting the Heads of Grain, and Grasses*; Jacob Peck, and Daniel Ashmore, Jefferson county, Tennessee, September 18.

This machine is intended to be driven forward like a wheelbarrow, when

grass seeds are to be collected, but for collecting the heads of grain, horses are to be employed to *drive* the apparatus, which, in its general form, resembles a cart. The machine must be mounted upon wheels of such height as will suit the grain, or grass, the seeds of which are to be collected. The heads, as the machine advances, are to be received between a row of lancet shaped knives, flat on the top, and beveled to a sharp edge from below. Fingers of wood, or of metal, may also project forward, the better to guide the heads to the knives. Above the knives there is a kind of revolving reel, set in motion by bands and whirls, connected with the running wheels of the carriage; this reel, or open cylinder, carries knives, which come nearly into contact with the row of fixed knives before spoken of, which cut off the heads of the grain, or the grass. There are various appendages to, and modifications of, this machine, described in the specification, which we cannot wait to notice.

"What we claim as our invention, are the lanceolate knives, or, in the stead of them, the series of fingers, with other knives, to steady the grain in cutting. The revolving wheel, with strikers, knives, and canvass. The collecting hand with its wheels, crank, lever, rest, and adjustment. The pulleys and band to drive the revolving wheel. The propelling power behind. The principle of the governor of the rudder to give direction to the machine; and the application of the whole to the use and purpose of cutting and collecting the heads of grain, leaving the straw on the ground, and in like manner saving clover and other grass seed."

We believe that it will be proved upon investigation that this claim embraces too many particulars, and thus includes things which have been before well known and employed. Rows of lanceolate knives are not new; the propelling from behind in grass and grain machines is not new; the driving a wheel by a band and whirls is not by any means a fit subject for a claim; yet there is certainly enough in the machine upon which to have procured a valid patent.

43. For an improvement in the manner of *Dressing Mill Stones*; David B. Napier, Casey county, Kentucky, September 18.

In a stone four feet in diameter, a circle of eight inches is to be described at the centre, and eight leading furrows are laid off, each of which forms a tangent to said circle, which gives the leading furrows four inches draught. Two short furrows are laid out between each of the leading furrows, the strip being still laid to the periphery of the draught circle; these latter terminate  $1\frac{1}{2}$  inch before they reach the leading furrows. The leading furrows are to be half an inch deep, and from one to one and three-fourths of an inch wide. The short furrows are one inch wide.

"The only right I claim is in graduating the long or leading furrows so as to receive the feed freely; and the draught of the short furrows so as to make them pass over each other at an angle of about 25 or 30 degrees."

44. For an improvement in the *Saw Mill Carriage*; Samuel Phelps, Mount Morris, Livingston county, New York, September 18.

This patent is taken for a very simple, yet, we think, a very efficacious and good mode of running back a saw mill carriage. The ways upon which it runs are to be furnished with friction rollers, and to be so inclined that the carriage will run back by its own gravity. An elevation of three or four inches in twenty feet is found to be sufficient for this purpose, when the

friction rollers are well made. The claim is to the mode of running back a saw mill carriage.

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45. For *Propelling Boats*; John L. Smith, Charleston, South Carolina, September 18.

This invention will not make a revolution in the art of propelling boats. The propeller is to be a screw, or some equivalent instrument; a cavity to receive this screw, is to be made by giving to the boat the form of a twin boat from about midships to the stern; the fore part, to the bow, being in the ordinary shape. The patentee calculates that this cavity will be filled with nearly still water, and that he will thence derive very great advantages, as will be seen by the following claim.

“What I claim as my own invention, and not heretofore used, in the above described improvement, is the peculiar devise by which I obtain the management of the body of comparatively still water, and the application of my propelling power therein, as has been already stated; or in other words, the manner of propelling boats or other bodies by means of screws, or other propellers, working in the dead or still water, obtained by such a construction of the vessel as shall leave a cavity, or cavities, or hollow space therein, open only to such a distance, and at such a point, or points, as may be deemed most advisable the screw, or other propellers, should be placed in.”

The screw has been tried often enough to prove that it is one of the most inefficient propelling instruments which have been essayed, and it may be safely predicted that the cavity in which the present patentee proposes to place it will not aid in redeeming its character.

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46. For *Manufacturing Glue*; Jonathan Morgan, Portland, Cumberland county, Maine, September 18.

This patent is taken for improvements in the apparatus employed in making glue, and in the mode of using it; the specification, describing these improvements, is one of very great length; and even the claims alone are too extensive for us to present to our readers. They relate to the construction of the boiler, with the application of steam to it. The construction of the netting frames on which the stock is suspended; a peculiar manner of making the pans employed; and also a washer wheel for cleansing the stock.

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47. For a *Cooking Stove*; Ezekiel Daball, North Canaan, Litchfield county, Connecticut, September 26.

The claims to this stove refer to the particular manner in which the parts of it are arranged, and contain all we think it necessary to give; they are the following.

“Those parts of this stove which I claim as my own invention are the following: the fixed horizontal plate over the fire, containing two orifices, corresponding in size and position to the two orifices in the top plate, together with the two swing dampers over that plate; another damper which shuts the space between said fixed plate and the oven; and also the two swing dampers between the top plates of the stove and the top plate of the oven; also the rim and two movable plates forming the top of the stove, and the invention described for changing the place of the movable plates; also the smaller pipe open at both ends, passing through the common stove

pipe, and the ventilation for carrying off the steam. These things I claim as my invention, and for them only do I claim letters patent of the United States."

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48. For *Cleansing Clover and other Grass Seeds*; Hiram Holt, Weld, Oxford county, Maine, September 27.

A cylinder, which may be two feet long, and the same in diameter, is to be covered with sheet iron, pierced so as to constitute a grater. Two concave shells, with like surfaces, are to be placed one on each side of this cylinder, leaving an opening at top for feeding, and at bottom for the escape of the seed. The cylinder, whose axis is horizontal, is to be made to vibrate backward and forward, to rub out the seed. The concaves are adjustable by screws. The claim is to this particular action of the cylinder, furnished with a concave on each side.

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49. For a *Machine for Turning Boots*; Sherburn C. Blodget, and Henry Boynton, Rowley, Essex county, Massachusetts, September 26.

This machine is for turning boot-legs, and the patentees claim the whole arrangement of it, which, they say, effects, with great facility and ease, what has hitherto been a troublesome operation.

A tube of tin, eight inches long, and four in diameter, is to be placed so as to stand vertically upon a suitable frame. The top and bottom of the tube are to be left open, the top having its edge smoothly turned over a wire, and the bottom being firmly attached to a perforated board, forming the top of the frame. The boot to be turned is placed over the tube, and two hooks, attached to a rod which passes up through the tube, are made to lay hold of the straps of the boot; the lower end of this rod is formed like a stirrup, and on pressing this down by the foot, the boot is drawn through the tube, and turned, the hands of the operator aiding in the process.

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50. For a *Cooking Stove*; Putnam Page, Sangerfield, Oneida county, New York, (assignee of D. Gage,) September 26.

It is stated in the specification that this patent is obtained for an improvement on what is called the *Bool* stove; and the said improvement consists mainly, if not entirely, in changing the dimensions of the fireplace, the oven, and certain other parts. There is not any thing which can properly be called a claim, but we are told that "the entire object of the improvement is, first, to forward the speed and conveniency in cooking and washing, and other business; secondly, to save a great proportion of the fuel usually taken and required in other stoves; thirdly, its durability, each piece being so shaped and constructed as not to be broken or cracked by the use of the fire."

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51. For a *Forge Back*; James Knickerbacker, Laporte, Laporte county, Indiana, September 26.

This forge back is to be of cast-iron, with a cast-iron box at the back of it, to receive the air from the bellows; there are to be two or more tuyeres, or few irons, to admit air into the fire, and these are to be furnished with valves, or stoppers, attached to rods which pass through the back of the box, so that they may be opened or closed at pleasure. The advantages which result from the use of a box are descanted upon as though this were a novelty, whilst the only new feature in this contrivance is the using more than

one tuyere, a thing of very doubtful utility in a common smiths' forge. The claim is to "the before described apparatus, and mode of regulating the blast of forges; but I make no claim to making the forge back and bottom of cast-iron." This claim is too broad, as the *apparatus*, with the exception named, is old.

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52. For an *Alarm for Steam Boilers*; Thomas Odiorne, Malden, Middlesex county, Massachusetts, September 26.

The specification says, "this is done by means of a tube extending from without to the inside of the boiler, through a fixed standard erect within, and through the sides or ends of said boiler, as the case may require, to which standard is attached a lever valve, closed by a spring, and opened by a sliding buoy, which as it settles down upon the falling surface of the water, presses upon the lever, opening the valve, when the escaping steam gives the alarm. This may be done by a ratchet wheel, by a buzz, by a bell, or by a trumpet, &c. The whole of this apparatus as applied and exemplified in my draught and *model*, I claim."

As regards the *model*, we do not refer to it for our own information, as it makes no part of the patent; the description is very general, and the drawing does not supply its deficiencies. The idea of giving an alarm by the subsidence of the water is a very familiar one; the mode proposed is not, we think, founded upon correct principles, as, in practice, a buoy that is to rise and fall, peaceably and quietly in the boiler, will not always do so.

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53. For an improvement in the *Chimney and Fire Place*; Moses Perin, Connersville, Fayette county, Indiana, September 26.

This appears to us to be a very strange kind of contrivance, and one which few persons are likely to adopt; it is not very clearly described, but sufficiently so to show that there is to be a kind of blower, or register, to regulate the draught; and, in front of the fire place, two or more sliding doors to close it up either entirely, or partially. "The combination of the parts, and the mode of putting them together," constitute the claim.

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54. For an improvement in the *Grist Mill*; Owen Moses, Malone, Franklin county, New York, September 26.

The stones in this mill are to run vertically, and are both of them to revolve, but in opposite directions. The shaft of one stone is to be a hollow tube, through which that of the other passes, and a horizontal crown wheel is to mesh into wheels on each of these shafts. The feeding is to be through the eye of one of the stones. There is no claim, and if it is supposed that the revolving of both stones, or the mode of gearing to effect this, is new; a little inquiry would manifest the erroneousness of such an opinion.

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55. For a *Spiral Cone Blower*; Benjamin Brundred, Oldham, Bergen county, New Jersey, September 26.

This is a revolving blower, acting upon the principle, but differing in form from, the ordinary winged blower. The casing is to be conical, with a shaft passing through its axis, upon which shaft there are to be wings set spirally. The air is to be admitted at the smaller, truncated; end of the cone, and is to escape through a tube, or tubes, at its lower end. The patentee tells us that "the great advantage of the spiral blower, over all other blowing machines now in use, consists in its spiral or screw like wings, revolving

with great velocity inside of the casing, and accurately set and curved so as to draw in and force forward the air."

No directions are given respecting the accurate setting and curving of the wings, and in the specification it is indicated that they may be straight. The thing may be good, but we do not see the source of its excellence. There is no claim made.

56. For a *Washing Machine*; John J. and Ebenezer C. Milliken, Winthrop, Kennebec county, Maine, September 26.

A trough is to be made in which there are to be two sets of vibrating stocks, of the ordinary form; a double crank shaft, the cranks at right angles with each other, is to work the levers by which the stocks are suspended; the cranks pass through slots in these levers, and are furnished with friction rollers, thus dispensing with pit-men, but by a much worse contrivance.

CLAIM.—"The application of a crank directly to the arms of the stock, in such a manner that one stock only shall press at a time. The application of friction rollers to the crank, as above described, &c.

57. For an improvement in the *Composition of Mead*; Theodore T. Kimball, and Adner H. White, Dedham, Norfolk county, Massachusetts, September 26.

One pint of sugar-house molasses, two table spoonsfull of wheat flour, one pint of new milk, and one pint of yeast, are to be put into a six gallon cask; air is then to be forced in by a force pump, and the cask stopped for twenty-four hours. At the expiration of this time, two gallons of boiling water, mixed with five pints of honey, or five pounds of loaf sugar, one third of an ounce of ginger, half an ounce of allspice; two ounces of essence of sassafras, a tea spoonful of essence of rose, and half an ounce of isinglass, are added, and the cask filled up with cold water. It is then to be corked up, and allowed to remain for twelve hours, and it is ready for use.

The claim is to "the use and application of the honey, or loaf sugar, the sassafras, the rose, and the isinglass; and the proportions of the last described composition."

58. For *Supplying Air to Forges*; Seth W. Watson, and Cloud Robinson, Ashtabula, Ashtabula county, Ohio, September 26.

This contrivance is in part like that described at No. 51; that is the tuyeres are to be supplied with stoppers in the same way; but instead of one box only, there are to be two, connected by a tube, so that the air blown into one may pass freely into the other; the fire is to be between these two boxes, each having its blow pipe, or tuyere. The claim is to "the carrying the air to the second from the first box, so as to let the air to the fire in counter currents, and in opposite directions, from the same bellows."

59. For an improvement in the *Art of Finance*; John Golder, city of Philadelphia, September 26. (See specification.)

60. For *Weaving Silk by the Power Loom*; Gamaliel Gay, Poughkeepsie, Dutchess county, New York, September 26.

This patent is obtained for "an improvement in the art of manufacturing silk;" which improvement consists in performing the operation of weaving in the power loom, to which purpose, it is said, that instrument has not here-

tofore been applied. The machinery is not claimed, as it is employed in the usual form, and only adapted to the weaving of silk.

A question has arisen whether such a patent is valid, and for its support reliance is placed upon that provision of the patent law allowing a patent for "a new improvement on any art." If silk can be woven upon the power loom with much greater economy than by any method previously adopted, it is contended that this constitutes such an improvement.

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61. For *Condensed or Concentrated Writing Ink*; John D. Myers, city of New York, September 26.

The claim made is to "the making of inks into a solid substance capable of being moulded into cakes, rolls, balls, wafers, pills; or the above substance reduced to a powder, or any other shape that may be desired, free from sediment, and fit for instant use by the application of warm or cold water."

The recipe given is very imperfect, mentioning only one of the ingredients of ink, and is as follows. "A watery extract is made from nut galls, &c. or any other matter suited for making black or coloured inks; thus forming a common writing ink. The whole is then filtered and carefully evaporated, by steam or other heat." Qu. May a person add water to dried up ink?

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62. For *Turning Short Curves on Rail Roads*; James Stimpson, Civil Engineer, Baltimore, Maryland. First patented August 23d, 1831. Patent surrendered and reissued, September 26. (See specification.)

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63. For the *Formation of Rail Road Plates for turning Curves*; James Stimpson, Civil Engineer, Baltimore, Maryland. First patented August 23d, 1831. Surrendered and reissued, September 26.

This patent might have merged in the foregoing, the specification of which we have given, but as the subject was divided into two parts originally, it has been thought best not to incorporate them in the reissue. The specification before us enters very much into details, and is too long for our pages, and as it cannot very well be epitomized, we shall give the claim only.

"What I claim as my inventions or improvements are, the employment of plates, or rails, either of cast or wrought iron, constructed upon the principle, or in the manner described, having narrow grooves for the flanches to run in, by which they are perfectly adapted to the unobstructed passing of all kinds of carriages used in streets, over them. The running of the peripheries of the flanches, or of the cone, or rise on the tread of the wheel, upon the rail, in the manner and for the purposes set forth. And the employment of plates of cast iron, upon the principle described, for the crossing of gutters, and the turning of curves."

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64. For a machine for *Shaving Shingles and Staves*; William H. Wilkinson, Wayne, Warren county, Ohio, September 26.

The articles to be shaved are to be forced over irons, fixed as plane irons, on the face of a bench. Two vertical wheels, acted upon in a way described, and shown in the drawing, serve to carry the articles over the irons. There is nothing in the machine worthy of special notice. The claim is to "the arrangement of the wheels acting upon the driver."

65. For improvements in the *Wheels and Machinery of a Saw Mill*; John Muir, Menallen, Fayette county, Pennsylvania, Sept. 26.

There are to be two wheels which are to be acted upon by the water in succession, the first a small flutter wheel, the second a larger one. They are to be geared together by wheels upon their gudgeons, and an intermediate shaft; the claim is to "the addition of the large water wheel and chute, and the gearing which connects the two."

66. For an improvement on his *Bedstead*, patented March 31st, 1834; Perry Prettyman, Georgetown, Sussex county, Delaware, September 26.

Our notice of the patent above alluded to will be found at p. 261, Vol. 14. The difference now made is but small, and as we fully described the original plan, we shall now give the claim only from the new patent, which is to "the pins across the mortises of the posts, and the pins through the rails and catches."

67. For a *Mortising Machine*; Charles Gates, Antrim, Hillsborough county, New Hampshire, September 26.

The claim made in the case of the above named machine, is to "the manner of arranging the several parts on to a common bench, so that they may be removed from the upper part thereof whenever they are not wanted, and returned at pleasure." It will be seen by this claim that there is nothing special in the operating parts of the apparatus.

#### SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a Patent for a Machine for spreading India Rubber upon cloth. Granted to WILLIAM ATKINSON, Lowell, Massachusetts, August 15, 1835.*

To all whom it may concern, be it known, that I William Atkinson, of Lowell, in the county of Middlesex, and State of Massachusetts, have invented an improved machine for the purpose of spreading caoutchouc, or India rubber, in solution, upon cloth, or other material, and of drying the same by steam, and I do hereby declare that the following is a full and exact description thereof.

The cloth to be coated with India rubber is to be made into an endless web, by sewing its two ends together; and other articles, such as skins of leather, may be coated therewith by spreading them on, and affixing them to, an endless web so made. This web is passed around cylinders which are made to revolve, and the dissolved caoutchouc or India rubber, is spread upon the endless web by the aid of a third cylinder, placed parallel to, and nearly in contact with, one of the cylinders around which the endless web passes.

The dimensions of the machine may, of course, vary, according to the width and length of the material to be coated or covered. In designating certain sizes and proportions of the respective parts, therefore, I do so only for the purpose of facility in description, and of indicating what has been found to answer well in practice.

I make a frame of wood, which may be sixteen feet long, and three feet six inches wide, the bottom timbers being sufficiently stout to support the carriage, and other parts, to be presently described. Into the ground

sills, or lower part of this frame, uprights are mortised, which serve to support a rail on each side, which may be three feet four inches from the floor, leaving, however, the sills sufficiently clear within the uprights to form a rail way upon which the rollers of a carriage may traverse back and forth.

Upon suitable supports, at one end of this frame, there are placed two cylinders of metal, usually of cast-iron, each of them one foot in diameter, and two feet nine inches long. The axes of these cylinders are in the same horizontal plane, and parallel to each other; around the inner cylinder the web to be coated passes; and the outer cylinder is made adjustable by means of screws, or otherwise, so that it may be brought into contact with, or removed to any required distance from, the web, or cloth. These cylinders are geared together by means of toothed wheels upon their shafts, cut sufficiently deep to admit of the requisite adjustment. The shaft of a pinion by which they are driven has on it a fast and a loose pulley; when revolving they turn inwards.

The second, or carriage cylinder around which the endless web passes, is supported upon a carriage, furnished with wheels, or rollers, which run upon the lower rails, or sills. This cylinder is also to be made of metal, and when used as a drying cylinder, it should be large in diameter, say three feet. A windlass is placed at the back end of the frame, from which ropes pass to the cylinder carriage, serving, by means of a winch, to draw the carriage, so as to render the cloth taut. Steam is to be admitted into the cylinder through a hollow gudgeon. For this purpose a steam tube is attached to the gudgeon, its other end passing through a stuffing box in a larger tube, attached to a boiler, thus admitting of the requisite motion of the carriage.

In order to apply the solution of India rubber to the cloth, &c., and to confine it to the proper width, we fit two cheeks, or pieces of wood or metal, so as to rest upon the two contiguous rollers, one at or near each of their ends, and these, when in their places, convert the rollers into a trough, or hopper, for containing the solution. The distance of these pieces from each other is regulated by attaching them together by means of a frame, or rod, at their upper sides, so that they may slide, and be affixed in their places by thumb screws, or otherwise.

When spreading the rubber on the cloth it is necessary to prevent its adhering to the outer roller, and this, among other methods, may be effected, by means of wet sponges, or brushes, laid along it, or by keeping it wet in any other way.

I intend sometimes to use the drying and the spreading apparatus detached from each other, in which case but two rollers, of any convenient size, will be employed in the drying process, and steam may then be introduced into each of them. I intend also, sometimes, instead of the large drying cylinder above described, to cause the cloth to pass over a stationary metallic box, or steam case, in its passage from the spreading to the straining or carriage roller, making the upper surface of this case convex, that the cloth may be kept in close contact with it; the space between the two sides of such box, or case, need not be more than from one to two inches.

What I claim as my invention, and for which I ask letters patent, in the above described apparatus, is a machine for spreading India rubber upon cloth constructed, and operating, substantially, in the manner of that herein set forth. I do not claim the mere spreading of the substance by means of cylinders, this having been previously done, but we do claim the employment of two cylinders for the purpose, connected together, and made to con-

cur, in producing this effect, acting upon the principles described. I also claim the general arrangement and application of the apparatus, for the drying of the solution by means of steam, either in combination with, or separate from, the spreading apparatus, as I contemplate the using of them either conjointly or separately, as hereinbefore set forth. I do not claim drying cylinders, or boxes, heated by steam, as my invention or discovery, but the combination and application thereof in the way, and for the purpose by me herein fully made known.

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*Specification of a Patent for an improvement in the manner of preparing and leaching Ashes, and manufacturing Potash. Granted to ELIJAH WILLIAMS, Harbour Creek, Erie county, Pennsylvania, August 15th, 1835.*

To all to whom these presents shall come—greeting,—Be it known, that I, Elijah Williams, of Harbour Creek, Erie county, State of Pennsylvania, have discovered and invented an improvement in preparing and leaching ashes and making Potash, and that the following is a full and exact description of the same, namely. The said improvement consists of two parts.

*First.* Burning over crude ashes in a large body, by building fires under, in, or on them, which will in a few days burn the coal and most other impurities out of them. They are then in a running hot state, and in this manner they are boiled in pure water, or weak lye, about fifteen minutes with a brisk fire, using about equal proportions of water and ashes; then add unslacked lime, in the proportion of about one bushel of lime to ten or twelve bushels of ashes. Boil a few minutes longer, and let it off in the leach during the effervescence.

*Second.* The boiled ashes are to be put in leaches from six to eight inches in depth, and boiling water applied until the strength is out of them; the ley is then boiled and melted down in the usual manner, this method produces a beautiful white article yielding from ten to fifteen per cent. more pure alkali than the best samples of commercial potash, manufactured upon any plan heretofore known, as I believe.

Lime has heretofore been used in many ways in the manufacture of potash, but the inventor claims that the plan of burning over, and boiling the hot ashes, and the unslacked lime and letting them into the leach during the effervescence, as before described, was discovered by him, and is the chemical process on which he depends: he also claims that he did invent the hereinafter described machinery for the purpose of manufacturing ashes. The boiler used for boiling ashes, or ley, should be made of sheet-iron, or copper, on the following construction. With a flat bottom, about three feet six inches in width, about seven feet in length from twelve to sixteen inches deep, with a tube in the side, or end, for the purpose of letting off the contents—the size of said boiler may be increased and diminished, and it is to be set in an arch for use; the leaching trough should be about twenty feet long, two and a half feet wide, and twelve or fourteen inches deep, with a flat bottom, having a lime strainer fixed about two inches above the bottom, and a tube below the strainer, for the purpose of letting off the ley.

*Directions.*—The boiler being set in an arch for use, put in of burned over hot ashes, about ten bushels, with as many bushels of water, or weak ley, boil with a brisk fire about fifteen minutes, then put in one bushel of unslacked lime, boil about as much longer if it does not go over, then let it

off into the leaching trough during the effervescence. A greater or less charge may be put in according to the size of the boiler and leaching trough. Have the boiled ashes from six to eight inches in depth in the leaches; then first put on weak ley, hot if you have it, after which continue with hot water until the strength is off, boil the ley, and melt down in the usual manner.

Clear ashes may be worked, (if not hot) by using more lime and boiling longer, but not to so good effect.

ELIJAH WILLIAMS.

*Remarks by the Editor.*—The practice of reburning the ashes was adopted, and proceeded in for a considerable length of time, more than forty years ago; and it was at first imagined that the amount of potash was thereby considerably increased. It was at length discovered, however, that the bulk was considerably reduced by the reburning, and that the apparent increase was principally due to this circumstance; the small increase produced by reducing the coal to ashes did not nearly compensate for the expense and labour of burning, and the plan was abandoned. We apprehend that the increased production spoken of by the patentee will be found to arise from the cause above stated.

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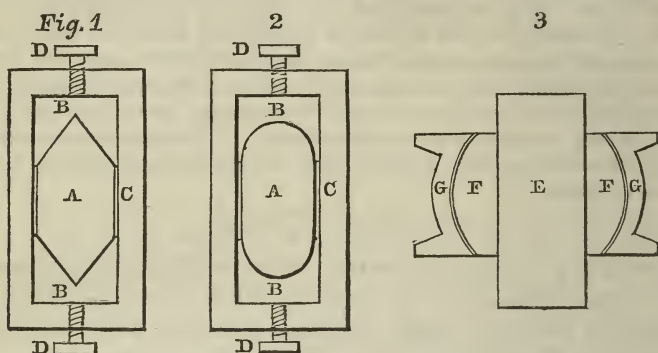
*Specification of a Patent for a Mode of Fitting the Boxes for Gudgeons into the Plummer Blocks; and also the fitting of the Bearing of the Slides for Locomotive and other Steam Engines, and for other purposes. Granted to MATTHIAS W. BALDWIN, city of Philadelphia, August 17th, 1835.*

To all whom it may concern, be it known, that I, Matthias W. Baldwin, machinist, of the city of Philadelphia, in the state of Pennsylvania, have invented a new and improved mode of fitting the boxes within which gudgeons are to run, into plummer blocks, and also of fitting and adjusting the bearings of slides, or guides, for piston rods; which inventions are applicable to locomotive engines, and also to other purposes. And I do hereby declare that the following is a full and exact description thereof.

The boxes in which the gudgeons used about locomotive and other steam engines, and machinery of various kinds, are received, and turn, have heretofore been fitted into the plummer blocks, or pedestals, made to receive them, by filing, or other analogous means, their ends being made either square, or angular, and adapted to corresponding parts in the plummer block, or pedestal, prepared to receive them. My improved mode of fitting them consists in turning or boring the opening, or seat in the plummer block, into which the boxes are to be fitted, so as to make each of the cheeks cylindrical segments. The boxes in which the gudgeon is to run, are then to be attached to each other by screws, or otherwise, and turned by means of a slide rest, or worked in any other manner, so as to make their ends cylindrical, and to cause them to fit exactly to the cylindrical cheeks, prepared for their reception, in the plummer block.

In constructing the slides for the pistons of locomotive and other steam engines, and for other purposes, the slide bar has usually been made square, or four sided, and its angles usually right angles; and the brasses, or bearings, contained in the box within which it slides, have been adjusted to it by set screws operating upon three sides thereof. In my improved mode of construction, the adjustment is made to operate upon two sides, or edges, only. For this purpose, I make my slide bar flat on two sides, and the

other two sides, or edges, half round, or otherwise form them into two planes, meeting each other along the middle thereof, by which means the rod will become six sided, this latter form being preferred to the rounding of the edges. The box within which the bar slides, is provided with two brasses, or bearing pieces, with hollows, or grooves, in them, adapted to the edges of the sliding bar, and fitting accurately between the parallel sides of the box; when, therefore, the brasses, or bearings, are adjusted to the edges of the rod by set screws acting against them, the rod is embraced by them so as effectually to check all tendency to a lateral motion, as will appear by an inspection of the drawings deposited in the Patent Office.



Figs. 1 and 2, cross sections of the box and slide bar, with angular and with circular fittings.

A, slide bar.

B, brasses, or bearings.

C, boxes.

D, adjusting screws.

Fig. 3, horizontal section of a plunger block and boxes, through the centre of the gudgeon.

E, gudgeon.

F, box.

G, cheeks of the plunger block.

What I claim as my invention, and wish to secure by letters patent, is the mode of fitting the boxes of gudgeons into plunger blocks, pedestals, or other receptacles, by boring, turning, or otherwise, so as to make the fittings cylindrical. I also claim the fitting of the slides for the pistons of locomotive engines, and for other purposes, into brasses, or boxes, adjusted and operating in the manner hereinbefore set forth.

MATTHIAS W. BALDWIN.

*Specification of a Patent for a mode of destroying Weevils, in Grain; to expel moisture from grain, meal, and manufactured flour, and for drying malt.*

*Granted to JAMES A. LEE, Administrator of James Lee, deceased, Maysville, Mason county, Kentucky, August 17th, 1835.*

To all to whom these presents shall come: Be it known, that James Lee, deceased, of the town of Vevay, in the county of Switzerland, and State

of Indiana, in his life-time, invented a new and useful improvement for destroying weevils and other insects and their eggs, in grain, meal, and manufactured flour, and for drying malt, and that the following is a full and clear description of the same, as invented or improved by him.

This improvement consists of one, or more, hollow cylinders, or prisms, made of sheet-iron, or other metal, of any required dimensions in diameter or length. Fixed on an angle in an inclining position, in the manner of a bolting-reel as is used in mills for bolting flour; it is enclosed in an oven or arched room, made of brick, stone, or other material, sufficiently wide to contain one or more cylinders, or prisms, aside of each other, and of height sufficient to admit of one or more stoves, or flues, calculated to communicate to the cylinders, or prisms, the quantity of heat required for destroying the living insects and their eggs in the grain, and for thoroughly expelling the moisture from the grain, malt, meal, or manufactured flour; the cylinders, or prisms can be moved either by hand, or machinery; the grain, malt, meal, or flour, is introduced through a hopper at the upper end of the cylinder, or prism, and by its inclining position and revolutions it is carried to the lower end, where it is discharged; in its passage down, the grain and malt is kept rolling, the meal and flour is constantly kept in a floating, pulverized state, not subject to concretion, or coagulation, and to prevent the meal, &c. from adhering to the cylinder, or prism, and being subject to be burnt, I fix several combs on the surface of the cylinder, to raise strikers of sufficient weight or force, to jar the cylinder, so as to disengage the meal, or flour, that may adhere to it.

By the process in this improvement the living weevils, or other insects, will be killed, and their eggs destroyed; the moisture in the grain, malt, or manufactured flour, and meal, will be effectually expelled, so that when re-packed into seasoned barrels, and stored in dry places, the grain, meal, or flour, may be kept sweet for years in the warmest climates, free from fermentation or putrefaction and the ravages of insects, and the malt dried as may be required, at the same time the germinated parts of the malted grain will be broken off by the revolutions of the cylinder, or prisms. It is not necessary that the meal or flour, should be cooled before repacking; the moisture being driven out, it cannot spoil, and may be suffered to cool in the barrels.

Now what I claim as new and as the invention of the said James Lee, deceased, for which I solicit letters patent, is, the use of the hollow, inclined cylinder, cylinders, or prisms; and strikers, in connection with a chamber, or oven, heated by means of stoves, or flues, operating in the manner and for the purposes herein set forth and described.

In testimony that the foregoing is a true specification of my late father's invention, or improvement, I have hereunto set my hand at the city of Washington, in the District of Columbia, this 3d day of August, 1835.

JAMES A. LEE, Administrator.

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*Specification of a patent for improvements in the process of, and apparatus for, Distilling Spirits of Turpentine and other articles. Granted to ISAIAH JENNINGS, city of New York, August 27th 1835.*

To all whom it may concern: Be it known, that I, Isaiah Jennings, of the city of New York, in the State of New York, have invented certain improvements in the process, and also in the apparatus employed, for the dis-

tillation of Spirits of Turpentine, the spirit from common tar, coal tar, and other analogous articles; and I do hereby declare that the following is a full and exact description thereof.

My improvement in the process when turpentine is to be distilled, consists in the addition of a portion of spirits of turpentine to the crude turpentine from which the distillation is to be made; the addition being made in such proportion as shall bring the turpentine into such a state of fluidity as shall admit of the subsidence of all the foreign matter contained therein as may be sufficiently heavy to fall to the bottom, and of the rising of chips, and other light materials to the surface, whence they may be readily removed, and the clear turpentine poured off from the sediment. The quantity of spirits of turpentine to be added will depend, in part, upon the warmth of the weather, or of the place in which the mixture is made; and also upon the thickness of the turpentine to be operated upon, and the impurities which it may contain. The mixture and separation of the impurities may be promoted by artificial heat, care being taken that the temperature is not such as shall occasion a waste of the spirit by evaporation.

The apparatus which I employ consists of two vessels within each of which a still worm of the usual construction is to be contained; or instead of the worm any kind of heater, or refrigerator, by which analogous effects are produced, may be employed; these vessels are to be connected together in a way to be presently described, and one of them is to answer the purpose of a still, whilst the other is to operate as a refrigerator, or condenser. The prepared turpentine is to be contained in any convenient reservoir whence it may descend through a tube into the worm which is to operate as a distillatory, its flow being regulated by a stop cock. The vessel containing this worm is to be closed at top, and the worm is to be heated by the introduction of steam, heated air, water, or other fluid; steam, however, being preferred; a sufficient degree of heat may be thus applied to separate the spirit from the rosin as the material descends from the top to the bottom of the worm. The lower end of this worm passes through the vessel, and into a large vertical tube which is placed between it and the refrigerator or condenser. This vertical tube rises as high as the top of the condenser, and descends several inches below the point at which the first named worm enters it, having below this point a tube for the discharge of the rosin, which, not being volatile, will descend and run out by its own gravity. Its flow may be regulated by a stop cock, and may be promoted, if necessary, by the application of heat to the bottom of the tube.

The vapour of the spirit will rise towards the upper end of the tube, whence it will pass into the refrigerating worm contained in the condensing tube, down which it will pass, and be condensed in the usual way.

I intend to apply the same apparatus to the distillation of common tar, coal tar, and other analogous articles, diluting them also, with a portion of their own spirit, or with any other which will produce a like effect.

What I claim as my invention, is the preparing the turpentine for distillation by diluting it with distilled spirit, and separating, by this means, the foreign matter therefrom, thereby producing a bright clear rosin, and an improved spirit. I also claim the employment of the worm, or other analogous apparatus, to be heated in the way described, and arranged and connected in the manner, or upon the principle herein set forth, so that it may answer the purposes for which it is ordinarily employed. I also claim

the preparing and distilling of common tar, coal tar, and other analogous articles by dilution, and subsequent distillation in the same apparatus.

ISAIAH JENNINGS.

*Specification of an improvement in the art of Public Finance, in loaning and actually employing credit. Granted to JOHN GOLDER, city of Philadelphia, September 26, 1835.*

To all to whom these presents shall come, be it known that I, John Golder, of the city of Philadelphia, in the State of Pennsylvania, have invented, discovered, and formed, a new and valuable accumulative or interest bearing check or credit chart, based upon a new principle in monetary negotiations, as a useful improvement in the art of finance, to be used only in the negotiation of loans upon contract with actual capitalists, or in the guarantee or transfer of bona fide deposits and investments to be made; a full and exact description of which impress, and drawing thereof, as invented by me, and hereafter is to be used as aforesaid, only excepting the names, sums, vignettes, which are at all times to be written and filled up in the own proper hand writing of the person or persons concerned, conformably to the contracts made, or to be made, with the party, or parties contracting therefor, is hereunto annexed. And the inventor and author claims as his invention, not only the design and writing of the chart, or check above described, and attached hereto; according to its specific form and definite advantages of creating and sustaining credit upon its peculiar solid principle of accumulative action, and the right and privilege of using it as an improvement in the negotiation of loans, and investment of capital, upon permanent visible security, but also the operative principle upon which it is based, which will admit of numerous variations in its form or manner of wording, or constructing the same, whilst the principle upon which it is intended to operate will remain substantially the same, and would therefore be necessarily considered as an evasion of my right.

JOHN GOLDER.

<p><i>Each check or chart is endorsed by the Actuary, negotiable on demand, in payment of instalments, or in purchase of stock.</i></p>		<p><i>Golder's Accumulative Patented Interest bearing Check or Chart.</i></p>	
<p>MUTUAL CREDIT OFFICE CHECK, OR CHART,</p>		<p>PAYABLE ON DEMAND, WITH INTEREST FROM DATE.</p>	
<p>No.</p>		<p>Philadelphia</p>	
<p>Actuary of Golder's Mutual Credit of Loan and Deposit Office, pay to the order of</p>		<p>or bearer,                      dollars and</p>	
<p>cents, with interest computed at                      per cent.,</p>		<p>from the entry hereof, the same being negotiated</p>	
<p>for, and payment guaranteed by actual deposit at</p>		<p>the Company's office this day.</p>	
<p>Entered                      day of                      183</p>		<p>Secretary, JOHN GOLDER, [L. S.]</p>	

*Industry is Gain.*

*Remarks by the Editor.*—When wheels, levers, or pistons are in question, we feel as though we could talk familiarly and intelligibly about them; but when “Divital inventions” and “Accumulative Checks” are upon the tapis, we are among foreigners and strangers whose language we do not under-

stand. We have never had occasion to become learned in monetary matters, being entirely destitute of the organ of pecuniary acquisitiveness. Under these circumstances we must not be looked to for any explanation of the plan before us, but as some of our readers are versed in the business of stocks and loans, it is, therefore, presented to them for their consideration.

Whether the foregoing is sustainable under a patent, does not depend upon its novelty merely, but more essentially upon the determination of the question whether the *Art of Finance*, can be classed among what are technically called "the useful arts."

*Specification of a Patent for an improvement in the Mode of Turning Short Curves upon Rail-roads, with Rail-road Carriages, particularly those round the corners of streets, wharves, &c. Granted to JAMES STIMPSON, Civil Engineer, Baltimore, Maryland, August 23d, 1831. Patent surrendered, and reissued on an amended specification, September 26th, 1835.*

I use, or apply, the common peripheries of the flanches of the wheels, for the aforesaid purpose, in the following manner.

I lay a flat rail, which, however, may be grooved, if preferred, at the commencement of the curvature, and in a position to be centrally under the flanches of the wheels upon the outer track of the circle, so that no other part of the wheels which run upon the outer circle of the track rails, shall touch, or bear upon, the rails, but the peripheries of the flanches, they bearing the whole weight of the load and carriage; while the opposite wheels, which run upon the inner track of the circle, are to run and bear upon their treads, in the usual way, and their flanches run freely in a groove, or channel; which treads are, ordinarily, about three inches in diameter, less than the peripheries of the flanches. Were the bearing surfaces of the wheels, which are in contact with the rails, while thus turning the curve, to be connected by straight lines from every point, there would thus be formed the frustrums of two cones, if there be four wheels and two axles to the carriage; or, if but one axle, and two wheels, then but one cone; which frustrums for the wheels representing their extremities, will, if the wheels are thirty inches in diameter, and are coupled about three feet six inches apart, turn a curve of about sixty feet radius of the inner track rail. The difference in diameter between the flanches and treads, before stated, the tracks of the usual width, and the wheels coupled, as stated, would turn a curve of a somewhat smaller radius if the axles were not confined to the carriage in a parallel position with each other; but this being generally deemed necessary, the wheels run upon lines of tangents, and those upon the inner track being as wide apart in the coupling as the outer ones, keep constantly inclining the carriage outwards, and thus cause the carriage to tend to run upon a larger circle than the difference in diameters of the treads and flanches would otherwise give; but the depth of the flanches, and the couplings, may be so varied as to turn any other radius of a circle desired.

What I claim as my invention, or improvement, is the application of the flanches of the wheels on one side of rail-road carriages, and of the treads of the wheels on the other sides, to turn curves upon railways, particularly such as turning the corners of streets, wharves, &c., in cities and elsewhere, operating upon the principles herein set forth.

JAMES STIMPSON.

*Foster and Avery's Rotary Steam Engine.*

We made some remarks on the subject of this engine in the last number and as it has attracted considerable attention, we have determined to publish the specification entire, in order that the nature and amount of the part claimed may be fully understood. This, with some further remarks upon it, was crowded out of the last number of the Journal, and, upon reflection, we have determined to omit the said remarks, and to give the specification alone. The original notice of this engine may be found at p. 171, vol. ix.—[EDITOR.]

*Specification of a Patent for an improvement in the Reacting Steam Engine.*

Granted to AMBROSE FOSTER, Brutus, Cayuga county, and WILLIAM AVERY, Salina, Onondaga county, New York, September 28th, 1831.

To all whom it may concern, be it known, that we, Ambrose Foster, of Brutus, Cayuga county, and William Avery, of Salina, Onondaga county, in the state of New York, have invented a certain improvement in the steam engine, commonly called the reacting engine, and that the following is a full and exact description of our said improvement.

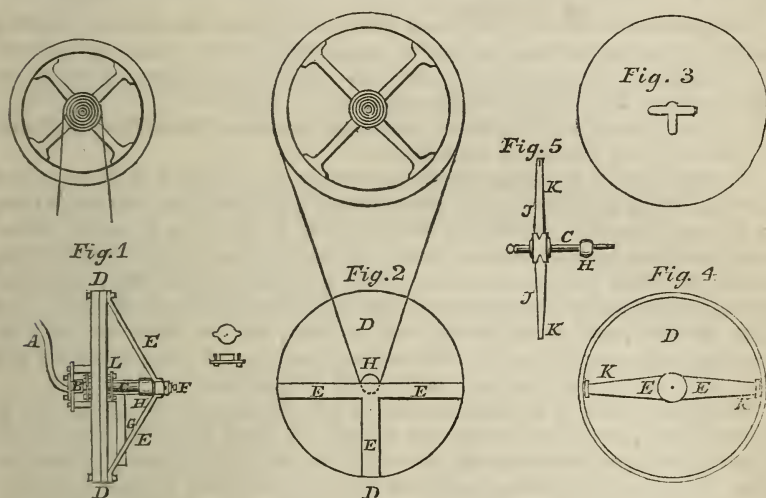


Fig. 1, in the accompanying drawing, represents a side view of the engine, the revolving arms not being visible, in consequence of their being enclosed in a circular case, to be presently described. A is a steam tube, connected with a boiler, and forming a steam-tight joint, in the box B, where it opens into the shaft C, which is made hollow to the requisite depth. D is the edge, or periphery, of a case, or drum, within which the arms from which the steam is to issue, revolve. E, E, are braces, which may be attached to the case, or drum, and at their junction support a socket, containing a centre pin, or screw, F, against which the shaft C is to run. G is a tube, through which the steam passing into the case from the revolving arms, is allowed to escape; a portion of this steam is employed to heat the water by which the boiler is to be supplied. H is a whirl upon the shaft

C, a strap from which may be employed to drive machinery. Where the same parts occur in the other figures in the drawing, they are represented by the same letters.

Fig. 2, shows the flat side of the drum, or case; the arms, or braces, E, E; the whirl, H, and the manner in which straps, or other gearing, may be carried from one wheel to another. Fig. 3, is the opposite side of the drum, or case.

E, E, in Fig. 4, shows the flat sides of the revolving hollow arms; and J, J, Fig. 5, is an edge view of the same. In Fig. 4, one side of the case is supposed to be removed, and, in Fig. 5, the whole case. At K, K, openings are made in the narrow edges of the arms, in directions opposite to each other, to allow of the escape of the steam introduced into them through the shaft C, with the hollow of which they communicate.

In an engine which we have in actual operation, the arms, E, E, (or J, J,) are each twenty inches in length. The width of the arms at the centre is about six inches, and at the ends about two and a half inches; in depth, or thickness, they are about one and a half inches near the centre, and about three-fourths of an inch near the end. The size of the holes through which the steam escapes, is about one-quarter, by one-eighth, of an inch. The holes are so perforated that the steam shall issue at right angles with the shaft.

We have found this engine to act with great power, but do not intend to confine ourselves to these particular proportions, as we mean not only to vary the size of our engines, but also the relative proportions of their respective parts, according to circumstances.

L, L, are parts of stuffing boxes, employed to prevent the escape of steam, in a manner well known to machinists.

We find it to be a point of great importance to give such a form to the revolving arms, as shall subject them to the least possible resistance from the air; we, therefore, instead of making them in the form of round tubes, which has been heretofore done, give to them the form which results from making each half of the arm a segment of a large circle, so that, when the two halves are united, the edges of the tube present acute angles. The tubes, however, may be made elliptical, or oval, and the same end will be, in a great measure, attained. We use any number of such arms on the same shaft, as we may find best adapted to our purpose.

We do not claim to be the inventors of the reacting steam engine, nor of the case, or drum, within which we intend the arms shall, in general, revolve; but what we claim as our invention, is, simply, the giving the oblate, or flat, form to the revolving arms, so that, in proportion to their capacity, they shall experience much less resistance from the air than that to which they have been heretofore subjected, thereby obtaining a greatly increased power.

AMBROSE FOSTER,  
WILLIAM AVERY.

## Progress of Theoretical and Practical Mechanics.

*Lever and Spring Balances.* By CHARLES T. COATHUPE.

The public are already indebted to the ingenuity of many for various contrivances adapted to the purpose of weighing. Some have vastly improved

the convenience of the old-fashioned beam. Others have devoted their attention to supersede the employment of weights, by the use of oval or spiral springs, and have produced very effective and perfect instruments, with all the accuracy necessary for their intention, such as Marriott's Dial, and Salter's Spring Balance. But no person has yet availed himself of the effects which are to be derived from the union of the two principles already adopted. It is, then, with all due deference to the better judgment of others, that I propose a machine of very easy manufacture, and small expense, by combining the lever with the spring balances of Marriott, or Salter, which appears to offer many advantages over either used alone.

Fig. 1 represents the arrangement for heavy weights, where we will suppose the distance from the fulcrum to the point of suspension to which the spring balance is attached, to be eight times the distance of the fulcrum from the point to which the weight is to be suspended. Salter's balances, graduated to weigh 24 lbs., and whose cost is about five shillings, will then weigh 192 lbs., and each  $\frac{1}{4}$  lb. division will indicate 2 lbs.

Fig. 1.

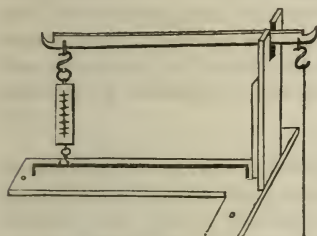


Fig. 2.

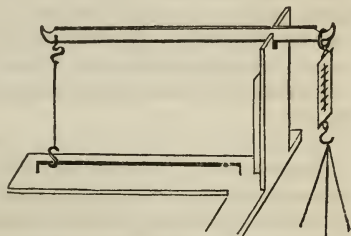
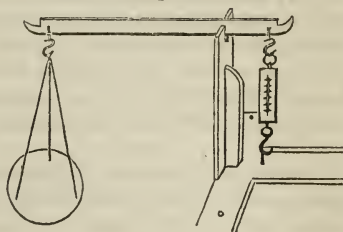


Fig. 2 is the reverse application, and may be used for light weights. Of course, each  $\frac{1}{4}$  lb. division will then represent only  $\frac{1}{4}$  oz.

Fig. 3 is merely the conversion of the lever to a simple hook for supporting the spring balance, when used in the ordinary manner for immediate purposes.

Fig. 3.



It is obvious that, with a combination of this kind, and using one of Marriott's dials, calculated to weigh 2 cwt., we may readily make it available for weighing a ton, and thus have not only the perfect use of the dial itself, when detached, but a machine capable of weighing very heavy packages without weights, thereby avoiding the expense of such weights, the trouble of removing them, and the risk of a false computation.—[*Lond. Mech. Mag.*]

*Effect of the velocity of Air upon its use in Smelting Iron.*—M. Teploff, one of the Russian Mining Corps, in an article on the improvements recently introduced into the smelting of iron in Russia, makes the following statement. In the smelting furnaces of the Ural, where the quantity and velocity of the blast are properly regulated, 1.4 of pig iron is obtained by 1 of charcoal fuel, while in other furnaces they obtain but .4 and .6 by the same consumption of fuel.

The velocity of the blast being increased, the heat within is increased, without a corresponding consumption of fuel. In an experiment made by order of the government, it was found that one hundred cubic feet of air, under a pressure of two inches of mercury, produced the same effect as two hundred cubic feet, under a pressure of one inch, with this difference, that, in the latter case, twice the fuel was consumed, which was required in the former case.

In one furnace which is mentioned, 22,000 lbs. of iron were obtained in twenty-four hours, by 16,000 lbs. of charcoal. Previous to the due regulation of the draught, they consumed twice this amount of fuel for the same yield of iron.

This economy is obtained by duly proportioning to each other the size of the blast pipe, and the pressure of the draught. The relation of these to each other, varies with the furnace.

M. Teploff asserts that the results thus obtained exceed those with the hot air blast, but it does not appear that any comparisons have been made under his examination, and with the charcoal fuel.

To regulate the draught, it is recommended to place two mercury or water gauges, one near the blast pipe, the other near the governor of the blowing machine. By varying the pressure, and the diameter of the nozzle of the blast pipe, making the latter smaller as the former is increased, and vice versa, the best proportion is to be ascertained.—[*Annales des Mines*, vol. vii.]

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*Preservation of Wood from Dry Rot.*—It is stated as the result of observations made in the German mines, that pine wood, which has been exposed to the action of water under pressure, is not subject to the dry rot. A stick of pine wood, placed in water in an iron pipe, absorbed, in thirty-six days, 27 per cent. of water. Subsequent exposure for thirteen days, in a warm room, evaporated  $15\frac{1}{2}$  parts of the water.

A similar stick of wood, exposed for the same time, but pressed, at intervals, by a force of nearly fifty atmospheres, absorbed 118 per cent. of water. Of this, when the wood was exposed as above stated for the other piece of timber, there evaporated 21 parts.

The wood was not sensibly increased in bulk by the absorption of the water. The bulk of water absorbed in the second experiment having been nearly one-thirty-ninth that of the wood.—[*Ibid.*]

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*Proportion of Ashes in different parts of Wood.*—A portion of heart wood, of sap wood, and of intermediate layers, of the trunk of an oak of sixty years of age, which had grown in a sandy loam, were separately burned. The heart yielded .27 per cent. of ashes, the middle layers .34 per cent., and the sap wood .532 per cent.—[*Journ. of Pract. Chem. (Germ.) Ann. des Mines*, vol. vii.]

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## Progress of Physical Science.

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*Experimental researches in Electricity. Eighth Series. By* MICHAEL FARADAY, &c. &c. *Phil. Trans. Lond.* 1835.\*

1. Metallic contact is not necessary to the production of the voltaic current. Decomposition of iodide of potassium is obtained by zinc and platinum

\* Abstract made for this Journal.—[COM. PUB.]

plates, immersed in part in a diluted acid, and separated above the acid solution by a piece of paper moistened with the iodide. The iodine appears at the platinum wire terminating the platinum plate.

2. Metallic contact is effective by opening a path for the voltaic current without introducing any new affinities to oppose that of the exciting fluid. Such an opposition would occur, if compounds capable of being decomposed by the current, were used to connect one set of extremities of the plates, while the other extremities were dipped into a dilute acid.

3. A simple galvanic circle is capable of effecting chemical decompositions when the elements of compounds are united by a weak affinity, or by proportioning the affinities producing to the current to those of the compounds to be acted upon.

The following compounds are placed in the order of facility of decomposition, the first requiring the lowest intensity of current.

Iodide of potassium (solution). Chloride of silver (fused). Protochloride of tin (fused). Chloride of lead (fused). Iodide of lead (fused). Muriatic acid (solution). Water acidulated with sulphuric acid.

4. "The electricity of the voltaic pile is not dependent either in its origin or its continuance on the contact of the metals with each other. It is essentially due to chemical action, and is proportionate in its intensity to the intensity of the affinities concerned in its production; and in its quantity to the quantity of matter which has been chemically active during its evolution."

5. "Volta-electric decomposition is simply a case of the preponderance of one set of chemical affinities more powerful in their nature over another set which are less powerful; and if the instance of two opposing sets of such forces be considered, and their mutual relation and dependence borne in mind, there appears no necessity for using, in respect to such cases, any other term than chemical affinity (though that of electricity may be very convenient,) or supposing any new agent to be concerned in producing the results; for we may consider that the powers at the two places of action are in direct communication, and balanced against each other through the medium of the metals, in a manner analogous to that in which mechanical forces are balanced against each other by the intervention of the lever."

6. "All the facts show us that the power commonly called chemical affinity can be communicated to a distance through the metals and certain forms of carbon; that the electric current is only another form of the forces of chemical affinity; that its power is in proportion to the chemical affinities producing it; that when it is deficient in force it may be helped by calling in chemical aid, the want in the former being made up by an equivalent of the latter; that in other words, the force termed chemical affinity and electricity are one and the same."

7. Chemical action is not of itself sufficient to produce an electrical current, the substance acting chemically must be in combination, and in such a state of combination as to be capable of decomposition by electricity. Thus liquid chlorine will dissolve the zinc of a voltaic battery, but no electrical current will result. It is not sufficient that a body act chemically, and be a conductor of electricity, it must be decomposable. Thus, metallic tin acting on platinum plates evolves no electricity.

It follows from this, that the sulphuric acid used in the battery evolves no electricity in combining with the oxide of zinc. It merely dissolves the oxide, exposing a fresh surface to oxidation.

8. Notwithstanding the extraordinary state which must be assumed by an

electrolyte either during decomposition, when an enormous quantity of electricity must be traversing it, or in the state of tension which is assumed as preceding decomposition, still it has no power of affecting a ray of polarized light, and hence no peculiar structure is to be inferred in this way.

9. The state of tension just referred to may be rendered evident by immersing in dilute sulphuric acid a single pair of galvanic cylinders, provided with cups to contain mercury, making an electrical communication for the plates by means of an amalgamated wire. On dipping one end of the wire into one of the mercury cups, and bringing the other end *near* the other cup, a spark passes through the intervening air.

10. Mr. Faraday next examines fully by experiment the following questions. Can electrolytes (bodies capable of decomposition by electrical currents) resist an electrical current below a certain intensity? Is the intensity at which the current ceases to act the same for all bodies? Will electrolytes thus resisting decomposition conduct electricity or serve as insulators?

(a.) A current excited by the action of dilute sulphuric acid on a pair of zinc or platinum plates was capable of decomposing iodide of potassium, but not water. The current evolved with the same plates, when nitric acid was added, decomposed water. A current which decomposes a solution of iodide of potassium may not be able to decompose one of sulphate of soda, the current being conducted in each of these cases.

(b.) In similar experiments fused chloride of silver was decomposed by a current which was conducted, without decomposition, by fused chloride of lead, and by fused nitre.

(c.) Water, whether pure or acidulated, seems to be equally decomposable by an electrical current, and has the same conducting power, whether pure or acidulated, for currents unable to decompose it.

11. A curious conclusion from the view of a certain electrical intensity being necessary to the decomposition of bodies is, that "we may arrange circumstances so that the *same quantity* of electricity may pass in the *same time*, in at the *same surface*, into the *same decomposing body*, in the *same state*, and yet differ in intensity, *decomposing in one case and not in the other*. For taking a source of too low an intensity to decompose, and ascertaining the quantity passed in a given time, it is easy to take another source having a sufficient intensity, and reducing the quantity of electricity from it by the intervention of bad conductors to the same proportion as the former current, and then all the conditions will be fulfilled to produce the result described.

12. In considering the effects of many alternations of simple galvanic circles, giving rise to the battery, Mr. Faraday gives the following view of the increase of intensity with the number of pairs of plates, while the quantity remains the same. "The electricity which passes across the acid from the zinc to the platinum in the first cell, and which has been associated with, or even originated by, the decomposition of a definite portion of water in that cell, cannot pass from the zinc to the platinum in the second cell without the decomposition of the same quantity of water there, and the oxidation of the same quantity of zinc by it." The quantity of electrolyte decomposed, and of electricity passed, must, as has been before shown, be the equivalents of each other. "The action in each cell, therefore, is not to increase the quantity set in motion in any one cell, but to aid in urging forward that quantity, the passing of which is consistent with the oxidation of its own zinc; and in this way it excites that peculiar property of the current which we endeavour to express by the term *intensity*, without increas-

ing the *quantity* beyond that which is proportionate to the quantity of zinc oxidized in any single cell of the series."

(a.) In proof of this position, ten pairs of amalgamated zinc and platinum plates were arranged with dilute sulphuric acid, forming a battery. When the circuit was completed, hydrogen was given off in each cell, and being collected, proved the same for each cell of the battery and chemically equivalent to the zinc dissolved.

(b.) This fact has been proved "long ago, in another way, by the action of the evolved current on a magnetic needle; the deflecting power of one pair of plates in a battery, being equal to the deflecting power of the whole, provided the wires used be sufficiently large to carry the current of the single pair freely; but the *cause* of this equality of action could not be understood whilst the definite action and evolution of electricity remained unknown."

(c.) "Whatever *intensity* may be," "there seems to be no difficulty in comprehending that the *degree* of intensity at which a current is evolved by a first voltaic element, shall be increased when that current is subjected to the action of a second voltaic element, acting in conformity and possessing equal powers with the first." Since the act of decomposition opposes a certain force to the electric current, and one which is of the same kind with this force, it is obvious that bodies may resist a current of one intensity, and give way to a more powerful one. Nor does this contradict the law of definite electrical action.

(TO BE CONTINUED.)

*Tellurium, and its Compounds with Oxygen.*—Pure tellurium may, according to Berzelius, be procured by mixing the ore with carbonate of potassa, or of soda and oil. The mixture is exposed to heat in a crucible. When the oil has been decomposed, the heat should be raised for a short time nearly to whiteness. Water passed through the substance remaining in the crucible dissolves the telluret of potassium. This liquid must be kept during the washing from air, if all the tellurium is to be extracted. The telluret of potassium exposed to the air deposits tellurium, the potassium oxidating. By distillation the metal is purified. To effect its conversion into vapour, the highest heat of a small wind furnace, aided by a stream of hydrogen gas, is necessary.

With proper precautions sulphurous acid may be used to precipitate tellurium from its solution in muriatic acid. The metal appears in flakes, and not as a black powder, as when obtained by the process above described.

Tellurium is brittle and crystalline. Its specific gravity is about 6.2. It vaporizes at a temperature at which white glass is too soft to confine the vapour. The odour of volatilized tellurium is different from either sulphur or selenium, to which bodies it is allied in its general character. The equivalent is nearly 8.02.

The substance commonly considered as oxide of tellurium, formed by the action of nitric acid on tellurium, Berzelius finds to be an acid for which he proposes the name tellurous acid. Of this acid he describes two varieties. One of them contains water, the other is anhydrous. They contain two equivalents of oxygen united with one of the metal.

Telluric acid is obtained by oxidating tellurous acid by nitre, or by acting upon tellurite of potassa by chlorine. Decomposing the tellurate thus formed by chloride of barium, and in turn decomposing the insoluble tellurate of baryta by sulphuric acid. This acid contains three equivalents of oxygen. The crystalized acid contains three equivalents of water.

The two acids just referred to are similar in composition to sulphurous and sulphuric acids. Berzelius was not successful in his attempts to procure hypo-telluric acid, nor in those to obtain a lower degree of oxidation than tellurous acid.—*Ann. de Chim. et de Phys.*

*Oxygen in Air contained in Snow.*—M. Boussingault found in snow water, collected in his descent from Chimborazo, but 16 per cent. of oxygen.—*Ibid.*

*Flint and Chalcedony not Simple Minerals.*—Professor Fuchs, of Munich, finds that opal, which is amorphous silica, dissolves in caustic potash even when in mass, and that in powder it is rapidly taken up. Powdered opal unites with lime in the moist way, and the mass hardens under water.—*Ibid.*

Flint is a mixture of quartz and opal, and the latter may be separated from fragments of flint by potash. Chalcedony contains more of it than flint.—*Jameson's Journal.*

*Temperature of the Earth, as shown by that of the Waters of Artesian Wells.*—M. Arago states as the result of observations not published, that the temperature of the water from these wells increases with the depth of the source, at the rate of one degree Fah. for every thirty-seven to fifty-four feet.—*Jameson's Journal.*

*Quantity of Rain at Different Elevations.*—The register of the rain fallen at Kinfauns Castle, for the year ending in December, 1834, gives 23.10 inches by a rain gauge in the garden, 20 feet above the level of the sea, 23.25 by a gauge in the Castle tower, 180 feet above the same level. The greater quantity at the upper level.

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## Mechanics' Register.

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*Berlin Iron Ornaments.*—Some of these are so fine, consisting of rosettes, medallions, &c., that nearly ten thousand go to the pound. In the coarse fabrics the value of the material is increased by manufacturing eleven hundred times, and in the finer nearly ten thousand times.—*Arcana of Science*, 1835.

*Mortality in Europe.*—It appears from tables of mortality in the principal states of Europe that there dies annually 1 inhabitant out of 28 in the Roman States, and the ancient Venetian provinces; 1 in 30 in Italy in general, Greece and Turkey; 1 in 39 in Netherlands, France and Prussia; 1 in 40 in Switzerland, the Austrian Empire, Portugal and Spain; 1 in 44 in Russia in Europe and Poland; 1 in 45 in Germany, Denmark, and Sweden; 1 in 48 in Norway; 1 in 53 in Ireland; 1 in 58 in England, and 1 in 59 in Scotland and Iceland.

*The Quadrant.*—In 1734 it was said, “as soon as the common prejudice against new things is worn off, and the instrument is well known, I do not believe any ship will go on a long voyage without one of these excellent quadrants.”

*A French Mechanic.*—M. Cavi was brought up a joiner. After serving in the army (what Frenchman is not a soldier?) he returned to Paris with a capital of 50 cents. He worked with a pattern maker during the day and in the evening took lessons in drawing; and as much of the night as could be spared from sleep worked upon the plans commenced in the drawing school. In 1823, he undertook the manufacture, in a small way, of steam engines, and in eight years had become possessed of stock in trade to the amount of one

thousand dollars. After losing two-fifths of this by the failure of an individual connected in the way of business with him, he succeeded in recovering himself so far that in ten years he had manufactured 123 steam engines, the total nominal power being 2,835 horses. He has made recently an iron steamboat, navigating the lakes Neuchatel, Thorun, &c. His present establishment enables him to furnish a steam engine of 160 horse power in a month.—*Baron Dupin*.

*Curious fact in relation to the Hedge-Hog*.—It is stated on the authority of M. Lenz and Prof. Buckland, that the most virulent animal poisons have no effect on the hedge-hog, and further on the authority of a German physician that prussic acid, arsenic, opium, and corrosive sublimate were given to an animal of the species, without injurious effect.—*Arcana of Science*, 1835.

*List of American Patents which issued in January, 1836.*

	January
1. <i>Water-proof silk hats</i> .—George B. Dexter, Boston, Mass.	6
2. <i>Belt saw for timber</i> .—Benjamin Barker, Ellsworth, Maine,	6
3. <i>Saw for felling trees</i> .—Walter Hunt, New York,	6
4. <i>Cleaning clover seed</i> .—James Manning, Lambertsville, New Jersey,	6
5. <i>Washing machine</i> .—Joab H. Hubbard, Bloomfield, Conn.	6
6. <i>Cutting wooden screws</i> .—Joseph Peavy, Levant, Maine,	6
7. <i>Dying hats</i> .—Aaron Gould, Washington, Conn.	11
8. <i>Lock for doors</i> .—Solomon Andrews, Perth Amboy, N. J.	11
9. <i>Cutting grain, &amp;c., mill for</i> .—William Gerrish, Portsmouth, N. H.	11
10. <i>Wharves, piers, &amp;c.</i> —John G. Pray, Brooklyn, N. Y.	11
11. <i>Napping machine</i> .—Stephen Marsh, Jericho, Vermont,	11
12. <i>Drills for metal, &amp;c.</i> —William R. Jones, Granville, N. Y.	11
13. <i>Hanging wagons, &amp;c.</i> —Henry Mellish, Walpole, N. H.	11
14. <i>Planting corn</i> .—Charles R. Belt, Washington city,	15
15. <i>Plough</i> .—John Dalkaner, Canton, Ohio,	15
16. <i>Bedsteads</i> .—Jonas Maguire, Philadelphia,	15
17. <i>Hydraulic cement</i> .—Levi Kidder, New York,	15
18. <i>Wells, &amp;c., covers of</i> .—Levi Kidder, New York,	15
19. <i>Packing tobacco</i> .—J. B. Allen, Richmond, Va.	15
20. <i>Ropes, &amp;c., making</i> .—John Whiteman, Philadelphia,	15
21. <i>Trunks, valises, &amp;c.</i> —James W. Noble, Pittsfield, Mass.	15
22. <i>Plough</i> .—Samuel Witherow, Gettysburg, Pa.	15
23. <i>Stove, air-tight</i> .—Isaac Orr, Washington city,	20
24. <i>Baker, reflecting</i> .—L. B. Olmsted, Binghampton, N. Y.	20
25. <i>Grooves in corset rings, &amp;c.</i> —Charles Buckland, Middletown, Conn.	20
26. <i>Thrashing machine</i> .—Ebenezer Brown, Chenango, New York,	20
27. <i>Horse power</i> .—Samuel Newton, Dayton, Ohio,	20
28. <i>Propelling boats</i> .—Philander Noble, Westfield, Mass.	20
29. <i>Plough</i> .—J. P. Chandler, and P. Ranger, Milton, Maine,	20
30. <i>Saddles and collars</i> .—Ebenezer Hale, New York,	23
31. <i>Hulling corn</i> .—Warren Carpenter, New Castle, Pa.	23
32. <i>Force pump</i> .—Benjamin Egbert, Lansing, N. Y.	23
33. <i>Stove-pipes</i> .—Ezra Ripley, Albany, New York,	23
34. <i>Sulkey seat</i> .—O. H. Capron, and G. Barton, Jr., Shaftsbury, Vermont,	23
35. <i>Packing flour</i> .—J. F. Barrett, Granville, N. Y.	23
36. <i>Wooden bridges</i> .—Stephen H. Long, Topographical Engineer, U. S.	23
37. <i>Hoes</i> .—Adna Allen, Ramapo, New York,	23
38. <i>Trap for rats, &amp;c.</i> —Thomas Neill, Herkersonville, Ohio,	23
39. <i>Hydraulic cement</i> .—John White, Syracuse, N. Y.	23
40. <i>Horse collar</i> .—John Hopkinson, Warren county, Ohio,	23

## CELESTIAL PHENOMENA, FOR MAY, 1836.

*Calculated by S. C. Walker.*

Day.	H <sup>r</sup> .	Min.	Sec.				
5	13	15		Im. a Sagittarii,	,5,6,	N. 140°	V. 102°
5	14	10		Em.		225	194
14	19	3	21	*Im. sun by moon,		320	265
14	20	13	26	N. App. centres,		212	158
14	21	32	33	Em. sun by moon,		104	55
20	8	44		Im. $\wedge$ Cancr,	,6,	67	124
20	9	47		Em.		253	308
30	11	47		Im. A Ophinci,	,4,5,	52	43
30	12	57		Em.		278	284

\* For irradiation, 5'', and 12.1s. to time of beginning.

† " " subtract 15.1 from time of end.

*Meteorological Observations for January, 1836.*

Moon.	Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Inches rise.	2 P.M.	Direction.	Force.		
☺	1	7 <sup>0</sup>	36 <sup>0</sup>	29.90	29.90	W.	Moderate.		Clear day.
☾	2	28	47	.93	30.00	SW.	Calm.		Clear day.
☾	3	25	35	30.15	.20	E.	Drizzle—cloudy.		Drizzle—cloudy.
☾	4	22	37	.20	.05	E.	Rainy day.		Rainy day.
☾	5	19	36	29.86	29.90	NE.	do.		Drizzle.
☾	6	31	31	30.13	30.24	E.	do.		Drizzle—cloudy.
☾	7	26	32	14	.00	NE.	Brisk.		Cloudy—light snow.
☾	8	33	33	29.66	29.60	E.	Blustering.	2.30	Rain.
☾	9	32	32	.50	.50	NE.	do.		Snow, 2 feet, drifted.
☾	10	27	30	.34	.34	W.	do.		Snow—cloudy.
☾	11	29	32	.54	.56	W.	Moderate.		Snow—clear.
☾	12	30	35	.70	.75	W.	do.		Clear day.
☾	13	32	40	.86	.94	W.	do.		Clear—cloudy.
☾	14	33	49	.96	30.00	W.	do.		Clear day.
☾	15	25	32	30.05	.05	W.	do.		Clear day.
☾	16	11	23	.15	.20	NW.	do.		Clear—lightly cloudy.
☾	17	14	27	29.90	29.76	NE.	do.		Snow—sleet.
☾	18	24	32	.50	.50	W.	do.		Steel—cloudy.
☾	19	21	29	.95	.95	W.	do.		Clear—lightly cloudy.
☾	20	11	34	30.10	30.15	W.	do.		Clear day.
☾	21	10	34	.20	.15	SE.	do.		Cloudy—lightly cloudy.
☾	22	36	41	29.70	29.70	NW.	do.		Rain—lightly cloudy.
☾	23	16	21	30.00	30.10	NW.	do.		Clear day.
☾	24	9	26	40	.45	NW.	do.		Partially cloudy—sleet with snow
☾	25	25	30	29.53	29.60	NW.	Blustering.		Cloudy—lightly cloudy.
☾	26	17	31	.91	.90	SW.	do.		Clear day.
☾	27	1	20	.96	.96	W.	do.		Clear day.
☾	28	1	11	30.00	30.03	W.	do.		Clear day.
☾	29	3	23	.00	.03	WSW.	do.		Lightly cloudy.
☾	30	17	32	29.90	29.90	SSW.	do.		Snow.
☾	31	34	32	.60	.54				
Mean	22.68	31.39	29.90	29.90					

Thermometer.

Maximum height during the month, 49. on 14th.

Minimum do. 1. on 8th.

Mean do. 29.90

Barometer.

30.45 on 24th.

29.34 on 10th.

In consequence of an accident which happened to the rain gauge, no estimate could be made of the quantity fallen since the 8th of January.

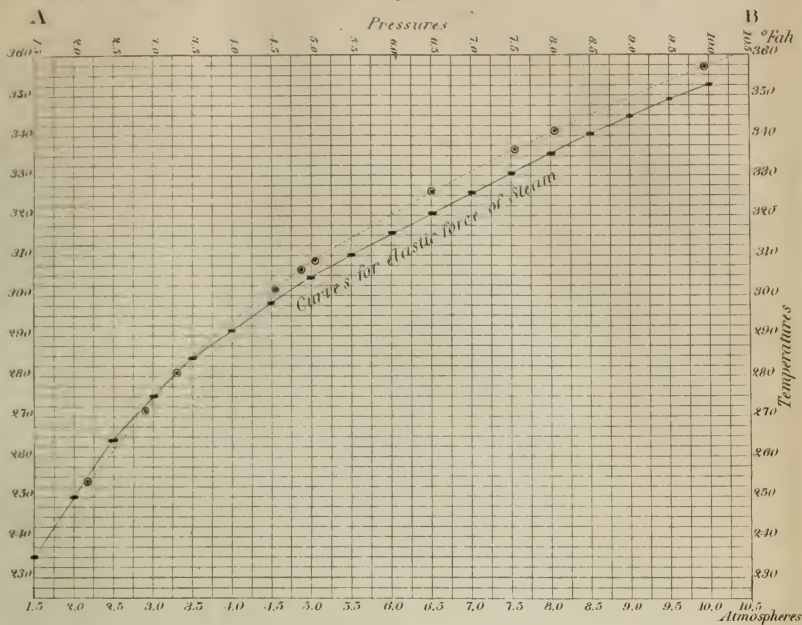
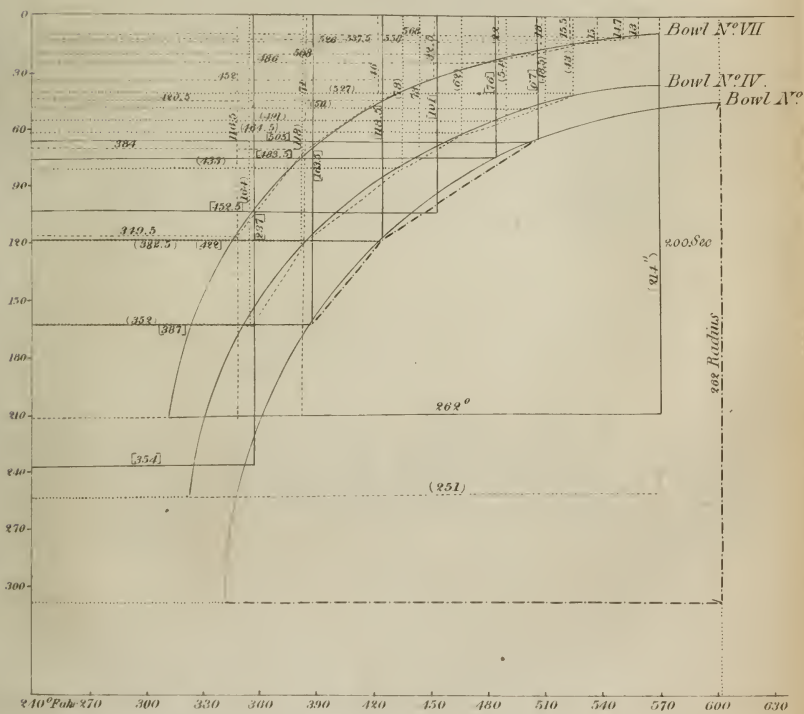
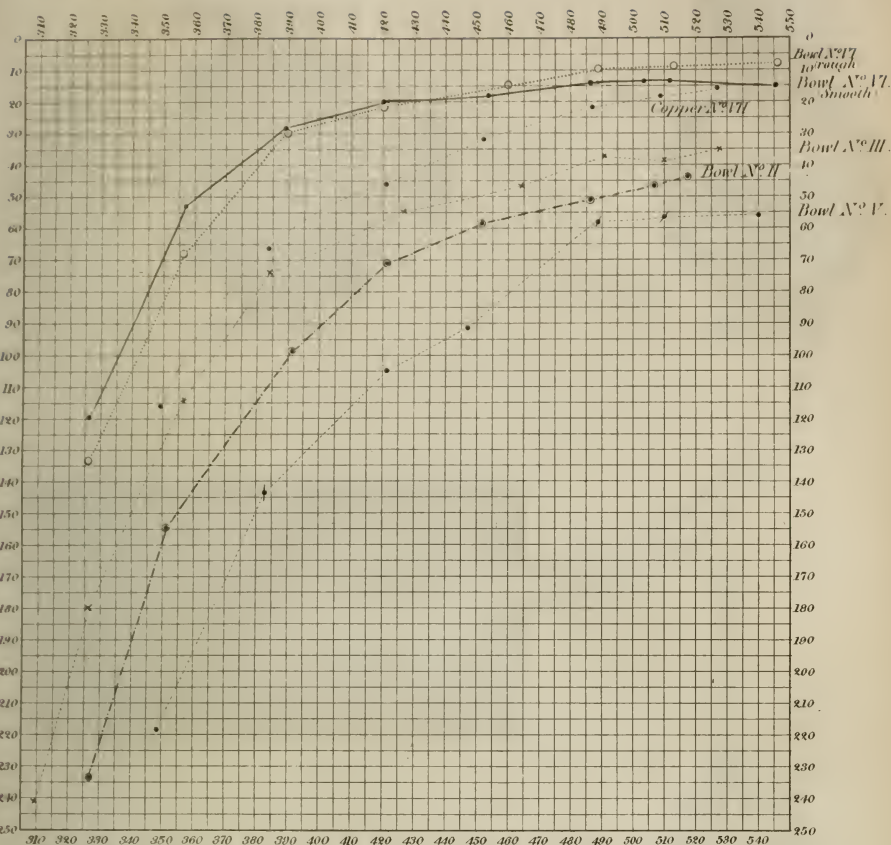


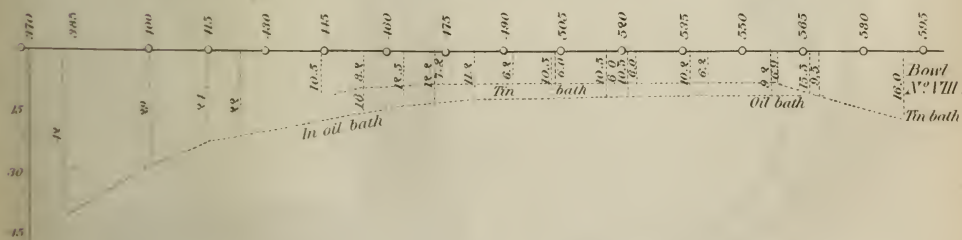
Fig. 1.





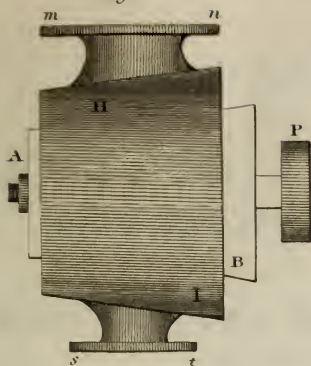


*Fig 2*

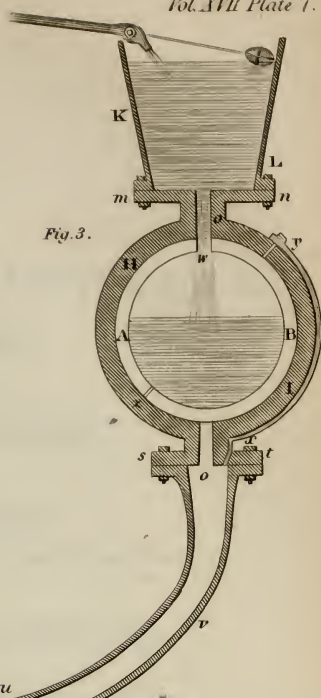




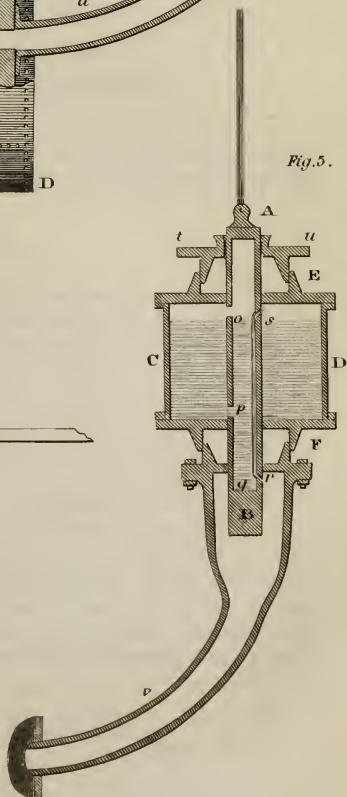
*Fig. 4.*



*Fig. 3.*



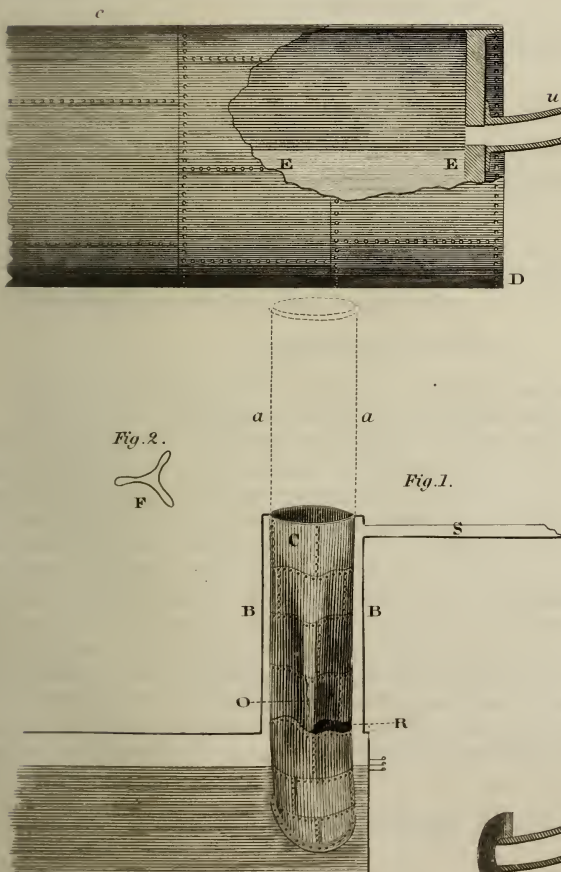
*Fig.5.*



*Fig. 2.*



*Fig.1.*





**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
Of the State of Pennsylvania,  
AND  
**MECHANICS REGISTER;**  
DEVOTED TO  
**Mechanical & Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

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MAY, 1836.

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**Practical and Theoretical Mechanics.**

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*Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.*

(Continued from page 233.)

**XII. On the elastic force of steam at working pressures.**

The committee, determined to put the apparatus which was necessary for other experiments, to the best use possible, in determining the elastic force of steam at different temperatures; and accordingly great pains were bestowed upon the graduation of the gauge, the regulation of the temperature of its parts, &c., the comparison of the thermometers, the maintenance of the scales at about the same temperature, &c.\* The small size of the boiler, and the various openings required to be made in it for the experiments which were the immediate objects of the committee, were unfavourable to the attainment of considerable pressures, but the discrepancies, even at working pressures, of the different tables of the elastic force of steam, made it important to push those trials as far as could be done without material changes. They succeeded without much difficulty in reaching ten atmospheres, which is but one atmosphere less than the reputed working pressure of our high pressure engines, and as the experiments on the safety valves have rendered probable, is very near the true working pressure.

\* See description of apparatus, &c., pp. 2, 3, 4, &c.

A series of results obtained in the trials of the fusible plates, is given below in the tabular form.

The table contains the temperature observed by the thermometer in the water, corrected for the error of the graduation; the temperature of the scale of the thermometer, with a view to show, that it was not allowed to vary too considerably; the observed height of the mercury in the gauge, reduced to its mean height; the temperature of the air in the gauge; its volume at the observed temperature; the volume reduced to 48°, the temperature of graduation of the gauge at which the column of mercury, equivalent to an atmosphere, is very nearly 30 inches; the elasticity of the compressed air, in inches of mercury; the correction in the height of the column of mercury, for the depression produced in the cistern below; the height thus corrected; the height after subtracting the sensibly constant number for the column of water between the level of the steam pipe from the boiler and the cistern of the gauge; the total elasticity in inches of mercury; the elasticity in atmospheres. The first number in the table is merely introduced for the convenience of presenting certain data required for subsequent calculation, it gives the height of the mercury in the gauge before beginning the observations, after correcting for the height of the barometer.

TABLE NO. 1. *Of the Elastic Force of Steam at different Temperatures.*

Temperature of Steam.	Temperature of scale of ther.	Height of air gauge.	Temperature of air in gauge.	Vol. of air at observed temp.	Vol. of air at 48° Fah.	Elasticity of air in inches of mercury.	.01 height of gauge.	Height + .01 height.	Height + .01 height — 1.29 inches.	Total elasticity in inches of mercury.	Elastic force in atmospheres of 30 inches.
Fah.°	Fah.°	Inches.	Fah.°	Vols.	Vols.	Inches.	Inches.	Inches.	Inches.	Inches.	Atmos.
		3.99*	62	8.33	8.101	27.26	.04	4.03	2.74	30.00	1.00
262 $\frac{1}{4}$	63	15.04	74	3.93	3.737	59.09	.15	15.19	13.90	72.99	2.43
265 $\frac{1}{2}$	71	16.34	"	3.43	3.259	67.76	.16	16.50	15.21	82.97	2.76
275 $\frac{1}{2}$	"	17.34	"	3.05	2.898	76.20	.17	17.51	16.22	92.42	3.08
286 $\frac{1}{2}$	"	18.94	"	2.44	2.319	95.23	.19	19.13	17.84	113.07	3.77
296 $\frac{1}{2}$	"	19.94	"	2.05	1.948	113.36	.20	20.14	18.85	132.21	4.41
298 $\frac{1}{2}$	73	20.11	"	1.99	1.891	116.76	.20	20.31	19.02	135.80	4.53†
302	"	20.44	"	1.86	1.767	124.98	.20	20.64	19.35	144.33	4.81‡
305 $\frac{1}{2}$	76	20.79	75	1.73	1.641	134.57	.21	21.00	19.71	154.28	5.14
313 $\frac{1}{4}$	79	21.39	"	1.50	1.422	155.30	.21	21.60	20.31	175.61	5.85§
317 $\frac{3}{4}$	80	21.64	"	1.405	1.332	165.79	.22	21.86	20.57	186.36	6.21
320 $\frac{3}{4}$	"	21.79	76	1.347	1.275	173.20	.22	22.01	20.72	193.92	6.46
327 $\frac{3}{4}$	"	22.24	"	1.176	1.113	198.41	.22	22.02	20.73	219.14	7.30
333 $\frac{3}{4}$	"	22.69	"	1.004	0.950	232.46	.23	22.92	21.63	254.09	8.47

\* This observation shows the height of the gauge before the experiment, corrected for the height of the barometer.

† Mean of 4 observations.

‡ Mean of 2 observations.

§ Mean of 2 observations.

A curve traced to represent these observations, the ordinates representing the pressures, and the abscissæ the temperatures, is quite regular, until the temperature corresponding to eight atmospheres is attained, when it rises abruptly. This fact was explained by examining the gauge; it was found that the cement used in attaching the glass tube to its ferule had become softened and had permitted the tube to rise. This defect was remedied and its recurrence prevented. It was then determined to repeat the entire series of observations, and to

carry them as high as could be done, with reasonable convenience, aiming particularly, to embrace the range of working pressures of the American engines.

The results are contained in the following table, in which the observed data, and calculated numbers, are arranged as in the last table. This table extends to 9.91 atmospheres and to the temperature of 352° Fah.

Care was taken that the elasticities were increased not too rapidly, and the last numbers obtained, were verified by keeping the temperature sensibly constant for a considerable time.

TABLE NO. II. *Of the Elastic Force of Steam at different Temperatures.*

Temperature of steam.	Temperature of thermometer scale.	Height of mercury in air gauge.	Temperature of air of gauge.	Volume of air at observed temperature.	Volume of air at 49° Fah.	Elasticity of air in inches of mercury.	.01 height of gauge.	Height + .01 height.	Height + .01 height — 1.29 inches.	Total elasticity in inches of mercury.	Elastic force in atmospheres of 30 inches.
Fah.°	Fah.°	Inches.	Fah.°	Vols.	Vols.	Inches.	Inches.	Inches.	Inches.	Inches.	Atmos.
248 $\frac{1}{2}$	54	5.56*	48	7.695	7.695	25.67	.06	5.84	4.55	30.00	1.00
269 $\frac{1}{2}$	—	14.04	53	4.32	4.277	46.19	.14	14.18	12.89	59.08	1.97
269 $\frac{1}{2}$	—	17.34	52	3.05	3.026	65.29	.17	17.51	16.22	81.51	2.72
284 $\frac{1}{2}$	—	19.64	"	2.17	2.152	91.76	.19	19.83	18.54	110.30	3.68
289 $\frac{1}{2}$	—	20.06	"	1.99	1.974	100.05	.20	20.26	18.97	119.02	3.97
294 $\frac{1}{2}$	—	20.56	53	1.82	1.802	109.63	.21	20.77	19.48	129.11	4.30
299 $\frac{1}{2}$	—	21.04	54	1.63	1.611	122.66	.21	21.25	19.96	142.62	4.75
304 $\frac{1}{2}$	—	21.34	54 $\frac{1}{2}$	1.52	1.500	131.66	.21	21.55	20.26	151.92	5.06
310 $\frac{1}{2}$	—	21.64	"	1.405	1.382	142.94	.22	21.86	20.57	163.51	5.45
314 $\frac{1}{2}$	58	22.04	55	1.25	1.233	160.26	.22	22.26	20.97	181.23	6.04
319 $\frac{1}{2}$	—	22.34	55 $\frac{1}{2}$	1.14	1.124	175.86	.22	22.56	21.27	197.13	6.57
329 $\frac{1}{2}$	—	22.84	56	0.95	0.937	210.84	.23	23.07	21.78	232.62	7.75
334 $\frac{1}{2}$	66	22.94	57	0.92	0.904	218.60	.23	23.17	21.88	240.48	8.02
338 $\frac{3}{4}$	—	23.04	57 $\frac{1}{2}$	0.887	0.870	226.92	.23	23.29	22.00	248.92	8.30
345	—	23.24	"	0.82	0.805	245.44	.23	23.47	22.18	267.62	8.92
348	—	23.34	58	0.787	0.771	256.05	.23	23.57	22.28	278.33	9.28
350	—	23.44	"	0.752	0.737	267.97	.23	23.67	22.38	290.35	9.68
352	—	23.50	"	0.733	0.719	274.92	.23	23.73	22.44	297.36	9.91
346	—	23.28	62	0.807	0.785	251.78	.23	23.51	22.22	274.00	9.13

\* This observation shows the corrected height of the gauge before the experiments.

There is one observation, namely, that at 329 $\frac{1}{2}$ °, which is certainly recorded erroneously; but omitting this one, the rest which are given, present a very tolerable regularity in the curve traced to represent them. For the sake of adding to the force of these results the scattered observations of temperatures and pressures incidentally made during the other experiments of the committee, are brought together in the annexed table.

A column is added to the table, to show the number of observations employed in obtaining the results.

TABLE No. III. *Of the Elastic Force of Steam at different Temperatures.*

Temperature of steam.	Temperature of thermometer scale.	Height of mercury in air gauge.	Temperature of air in gauge.	Volume of air at observed temperature.	Volume of air at 48° Fah.	Elasticity of air in inches of mercury.	.01 height of gauge.	Height of gauge + .01 height.	Height + .01 height — 1.29 inches.	Elasticity of steam in inches of mercury.	Elastic force in atmospheres.	No. of observations.
Fah.°	Fah.°	Inches.	Fah.°	Vols.	Vols.	Inches.	Inch.	Inches.	Inches.	Inches.	Atmos.	
234	54	3.91*	59	8.35	8.169	27.34	.04	3.95	2.66	30.00	1.00	
239 $\frac{1}{4}$	62	8.80	55	6.39	6.301	35.45	.09	8.89	7.60	43.05	1.43	1
245 $\frac{1}{2}$	68	9.94	61	5.94	5.788	38.59	.10	10.04	8.75	47.34	1.58	2
250 $\frac{1}{4}$	70	11.16	63	5.46	5.300	42.14	.11	11.27	9.98	52.12	1.74	5
256 $\frac{1}{4}$	73	12.54	64	4.92	4.776	46.77	.12	12.86	11.37	58.14	1.94	4
262 $\frac{3}{4}$	77	13.88	63	4.33	4.243	52.64	.14	14.02	12.73	65.37	2.18	5
271	70	15.14	64	3.89	3.768	59.27	.15	15.99	14.00	73.27	2.44	2
278	75	16.34	65	3.43	3.316	67.35	.16	16.50	15.21	82.56	2.75	4
288 $\frac{1}{4}$	77	17.44	70	3.01	2.882	77.49	.17	17.61	16.32	93.81	3.13	3
291	75	18.74	68	2.50	2.403	92.94	.19	18.93	17.64	110.58	3.69	3
292 $\frac{1}{2}$	76	19.14	65	2.36	2.282	97.88	.19	19.33	18.04	115.92	3.86	2
300	65	19.44	63	2.25	2.184	102.26	.19	19.63	18.34	120.60	4.02	3
303	73	20.12	65	1.98	1.914	117.33	.20	20.32	19.63	136.36	4.55	4
303 $\frac{1}{2}$	74	20.54	66	1.82	1.756	127.27	.20	20.74	19.45	146.72	4.89	1

\* This observation shows the corrected height of the gauge before the experiments.

This table enables us to go as low as 1.43 atmospheres, and is strikingly accordant with the two others as far as they extend in common.

A curve which would be traced by the following table, which may be considered to represent the mean of the foregoing, would differ little more than one-tenth of an atmosphere in any part of the range, from the observations, omitting one noticed in the first, and another noticed in the second table; the pressures in general differing less than one-tenth of an atmosphere from the observed pressures.

TABLE of the Elastic Force of Steam, from one to ten Atmospheres.

Pressure.	Observed Temp.	Pressure.	Observed Temp.	Pressure.	Observed Temp.	Pressure.	Observed Temp.	Pressure.	Observed Temp.
Atmos.	Fah.°	Atmos.	Fah.°	Atmos.	Fah.°	Atmos.	Fah.°	Atmos.	Fah.°
1	212	3	275	5	304 $\frac{1}{2}$	7	326	9	345
1 $\frac{1}{2}$	235	3 $\frac{1}{2}$	284	5 $\frac{1}{2}$	310	7 $\frac{1}{2}$	331	9 $\frac{1}{2}$	349
2	250	4	291 $\frac{1}{2}$	6	315 $\frac{1}{2}$	8	336	10	352 $\frac{1}{2}$
2 $\frac{1}{2}$	264	4 $\frac{1}{2}$	298 $\frac{1}{2}$	6 $\frac{1}{2}$	321	8 $\frac{1}{2}$	340 $\frac{1}{2}$		

To compare our results with those given by the committee of the French Academy, we have traced, on Plate 5, a curve, from the above table, and another from those of the thirty observations, selected by the committee of the Academy, from their experiments, below ten atmospheres. The curve

of our observations, passes at low pressures nearer to the line AB than that of the French experimenters, and after coinciding at the medium pressures of the table, crosses the latter, differing at ten atmospheres 5 degrees, or at  $352\frac{1}{2}$  degrees .65 of an atmosphere. The curve of our observations is traced in a full line, that of the French Academy is dotted.

The difference here noticed is too considerable to be admitted, as within the limits of errors in the apparatus or in observation. Having an authority of so much weight against them, the committee have been driven to examine their results very closely. The care employed in the graduation of the gauge seems to exclude the idea of error from it; the upper portion of the scale was divided to .05 of an inch, and could easily be read to half of that distance, making about .1 of an atmosphere at the highest pressure attained. A specific correction for capillarity was ascertained and employed. In one point of manipulation, namely, the method employed to dry the air, the committee differed from what was usual, and though they think there is reason to confide in that method, they have examined what effect would be produced if the air were saturated with moisture. Recent experiments, on the passage of gases, out and into vessels placed over mercury, and observations connected with them, warrant, moreover, a suspicion that dry air standing in a glass vessel over mercury, the surface of which covered by water, may become impregnated with vapour. The effect of such a source of error they have calculated\* in the highest and lowest results of table No. II. and find it to be as follows:

For  $248\frac{1}{4}^{\circ}$  the tension of the vapour is 1.96 instead of 1.97, and  
 „ 352 „ 9.78 „ 9.91.

Differing from the numbers given in table No. II. by .01 and .13 of an atmosphere.

This supposition is thus shown to be inadequate to explain the discordance, and must, in fact, be deemed, to a certain extent, gratuitous.

The committee have next compared the results furnished by the safety-valves graduated independently of the gauge, and these, as has already been shown, gave calculated pressures four per cent. and ten per cent. higher than the pressures indicated by the gauge. From these independent experimental data we have then an evidence that our results are, probably, not too high.

\* If  $v$  be the volume of moist air and  $v'$ , that of the dry air corresponding to it,  $e$  the elasticity of the air when expanded by the moisture, and  $e'$  of the dry air equivalent in elastic force to the mixture, and  $t$  be the tension of the vapour in the air, then the volume of the air being increased by the presence of the moisture, and the elasticities being inversely as the volumes.

$$e : e' :: v' : v, \text{ whence } v' = \frac{e v}{e'}$$

$$\text{but, } e = e' - t, \text{ whence } v' = v - \frac{v t}{e'}$$

This equation is true at all pressures if we suppose the space originally to be saturated with moisture; for as the space becomes less, a portion of the vapour will be converted into water. The value for  $e'$  may be derived in any assumed case from Table II. page 78.

To apply these remarks. From the first line of Table No. II. we have  
 $v = 7.695$ ,  $e' = 25.67$ ,  
 and from Mr. Dalton's experiments,  $t$  corresponding to  $48^{\circ}$ , is .35 of an inch.

$$\text{whence } v' = 7.695 - \frac{7.695 \times .35}{25.67}, \text{ or } v' = 7.495$$

For  $248\frac{1}{4}^{\circ}$ , Table No. II. gives  $v = 4.32$ ,  $e' = 46.19$ , and the temperature  $53^{\circ}$ , whence  $t = .41$  and  $v' = 4.28$  at  $53^{\circ}$ , and the elastic force of the steam is 1.94 atmospheres.

In like manner for  $352^{\circ}$ ,  $v' = 0.732$  at  $58^{\circ}$  and the first result for  $v$ , that at  $48^{\circ}$ , which gives 7.495 volumes, makes the corresponding pressure 9.78. This number differs but .13 of an atmosphere from that in the table.

The question of the elastic force of steam has been examined by many experimenters, and with very various results. The committee propose to show the state of knowledge on the subject by comparing the principal series of experiments referring to temperatures above  $212^{\circ}$ , with their own, which are now under examination. In the first table, below, they have compared their results with those of Robison,\* of Ure,† and of Taylor‡.

The first two experimenters named, used an open mercury gauge in their experiments, and the thermometers were exposed to the pressure of the steam.

This latter circumstance would tend to render the observed temperature slightly too high, or the observed pressure, relatively to the temperature, too low, as far as it produced any effect.

Elastic Force of Steam in Atmospheres.							
Temp. of steam in degrees Fah.	Committee of Franklin Institute.	Prof. Robison.	Difference.	Dr. Ure.	Difference.	Mr. Taylor.	Difference.
212°	1.00	1.00	.00	1.00	.00	1.00	.00
240	1.64	1.83	— .19	1.72	— .08		
250	2.00	2.23	— .23	2.06	— .06	1.97	+ .03
260	2.35	2.68	— .33	2.41	— .06	2.34	+ .01
270	2.74	3.14	— .40	2.88	— .14	2.75	— .01
280	3.25	3.53	— .28	3.40	— .15	3.26	— .01
290	3.89			4.00	— .11	3.82	+ .07
300	4.60			4.66	— .06	4.46	+ .14
310	5.50			5.38	+ .12		
320	6.40					5.98	+ .42

The experiments of Watt are not referred to, as he states himself, that he has doubts of their accuracy, and defers to the results of Mr. Southern, which will be given presently.

The results of the committee, as to pressure corresponding to temperature, all fall below those of Professor Robison, the extremes being .14 and .40 of an atmosphere, they approach nearer to those of Dr. Ure, differing in the extremes — .06 and + .12 of an atmosphere. They agree even more nearly with the experiments of Mr. Taylor, tending, generally, to gain upon them; thus at  $260^{\circ}$  the difference is .01 of an atmosphere, and at  $320^{\circ}$  is .42. The temperature corresponding to six atmospheres, in the table of the committee, is  $315\frac{1}{2}^{\circ}$ , to the same (5.98) in that of Mr. Taylor,  $320^{\circ}$ , and to the same in that of the French commission, 320.4, the latter two agreeing very closely.

In the following table are given a comparison of the experiments of the committee, with those of Mr. Southern,§ Professor Arzberger,|| of Vienna, and the Commission of the Academy of Paris.¶ The pressures were obtained in the experiments of Mr. Southern, by a piston valve, which is stated to have been checked, in part, by a mercury gauge; in the experiments of Professor Arzberger by a spherical valve of steel; and in those of the French commission, by a closed gauge, containing air. The numbers for these last named re-

\* Robison's Mech. Philos. vol. ii.

† Phil. Trans. 1818.

‡ Phil. Mag. vol. ix.

§ Robison's Mech. Philos. vol. ii.

|| Tredgold on Steam Engine, quoted from Bull. Sc. Tech. vol. i.

¶ Annales de Chim. et de Phys. vol. 43.

sults are those deduced from the empirical formula adopted as representing, most closely, the experiments.

Pressures in atmospheres.	Temperatures.						
	By experiments of Com. of Frank. Inst.	By Mr. Southern.		By Prof. Arzberger.		By Commission of French Academy.	
	Fah.°	Fah.°	Difference.	Fah.°	Difference.	Fah.°	Difference.
1	212						
2	250	250.3	—0.3	249*	+1.0	250.5	—0.5
3	275			274†	+1.0	275.2	—0.2
4	291½	293.4	+1.9			293.7	—2.2
5	304½					308.8	—4.3
5.87	314½			322	—7.7	318.8	—4.5
6	315½					320.4	—4.9
7	326					331.7	—5.7
8	336	343.6	—5.6			342.0	—6.0
9	345					350.8	—5.8
10	352½					358.9	—6.4
10.83				372		362.8	

\* 1.97 atmospheres.

† 2.96 atmospheres.

From these comparisons it appears that for given temperatures the pressures determined by the committee, are lower than those found by Professor Robison, between 1 and 3½ atmospheres; lower than those of Dr. Ure, from 1 to 5½ atmospheres, except at the highest pressure, differing, however, but little from them; nearly the same from 1 to 2¾ atmospheres with those of Mr. Taylor, and higher from 2¾ to 6 atmospheres; higher than those of Mr. Southern; much higher than those of Professor Arzberger; higher than those of the French Commission.

The temperature given by the committee for the pressure of 8 atmospheres differs about 3° from that inferred from the temperature given by Christian\* for 7.8 atmospheres; viz. 337° Fah.

The empirical formula, adopted by the committee of the French Academy, as representing the law of relation between the pressure and temperature of steam, is of the form.

$$e = (a + nt)^5$$

Where  $e$  represents the elastic force of the steam,  $t$  the temperature, and  $a$  and  $n$  are constants, determined as well as the index, 5, from observation.

Tredgold had previously adopted a formula similar to this, in form, as agreeing nearly with the best experiments, to which he had access, and which have already been compared with the results obtained by this committee. Of this formula the French Commission remark, that the numbers which it gives, accord at the lower temperatures of their series, better with their experiments than those furnished by their own formula. Besides the differences in the numerical coefficients between the two formulæ now in question, Tredgold's formula has the number six instead of five for an index. In other words

\* Quoted by Mr. Ivory, from Meeh. Indust. vol. ii.

the elasticity increases more rapidly with the temperature than would be shown by the formula written on the preceding page.

With this law the experiments of the committee coincide; the index six applying much more nearly to their results than five. The empirical formula adopted to represent their results is

$$e = (.00333 t + 1)^6$$

where  $e$  is the elasticity of the steam in atmospheres, and  $t$  the excess of temperature above the boiling point of water in degrees of Fahrenheit's scale.

This formula will be found to accord very well at the higher pressures with the experiments of this committee, and its variations from them at other pressures to be sometimes in excess, and at others in defect.

This will appear by calculating the values of  $t^*$  for the different pressures recorded in the table of the committee, on page 292, and comparing them with the numbers found by experiment.

*Comparison of Temperatures calculated by the Formula, with those deduced from Experiment.*

Elastic force.	Calculated temp.	Temp. by exper.	Difference.	Elastic force.	Calculated temp.	Temp. by exper.	Difference.
Atmos.	Fah.°	Fah.°	Fah.°	Atmos.	Fah.°	Fah.°	Fah.°
1	212.0	212	0.0	6	316.5	315½	+1.0
2	248.8	250	-1.2	7	327.3	326	+1.3
3	272.3	275	-2.7	8	336.4	336	+0.4
4	290.1	291½	-1.4	9	344.8	345	-0.2
5	304.4	304½	-0.1	10	352.5	352½	0.0

The comparison indicates that at the lower temperatures, the elasticity, as shown by the formula increases too rapidly, but from four up to ten atmospheres, the differences between the calculated and mean temperatures are less than one degree and a half of Fahrenheit's scale. The differences have sometimes the positive and sometimes the negative sign, which is favourable to the correctness of the formula as representing the law of increase of elasticity, in terms of the temperature.

In conclusion, it seems to the committee, that while the differences in the results of experimenters are greater than the present state of experimental science warrants, yet at pressures even exceeding ordinary working pressures, the relation of the temperature and pressure of steam may be considered, in a practical point of view, as sufficiently determined.

\* The formula gives,  $t = \frac{e^{\frac{1}{6}} - 1}{.00333}$ , or

$$\text{Log. } t = \text{Log. } (e^{\frac{1}{6}} - 1) - \text{Log. } .00333.$$

Presented to the Board of Managers of the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, and approved.

ISAAC HAYS,

*Chairman Board of Managers.*

ATTEST,

WILLIAM HAMILTON, *Actuary.*

*Philadelphia, January, 1836.*

We append to the foregoing report of the Committee on Explosions, a document which appears in the authorized copy of the report as a preface, and which contains an account of the transactions of the Committee.

COM. PUB.

## PREFACE.

The Committee, whose report of experiments, made by the request of the Secretary of the Treasury of the United States, is presented in the following pages, was appointed on the 10th of June, 1830, for the purposes expressed in the annexed resolution of the Board of Managers of the Franklin Institute, of the State of Pennsylvania, for the promotion of the Mechanic Arts.

*“Resolved, That a committee of seventeen members be appointed, to examine into the causes of the explosions of the boilers used on board of steam-boats, and to devise the most effectual means of preventing the accidents, or of diminishing the extent of their injurious effects.”\**

The Committee consisted of the following named members of the Institute.

Alex. D. Bache, *Chairman.*

Robert Hare, M. D.

S. V. Merrick,

W. H. Keating,

Isaiah Lukens,

James J. Rush,

James Ronaldson,

Frederick Graff,

R. M. Patterson, M. D.

J. K. Mitchell, M. D.

Benjamin Reeves,

George Fox,

Thomas P. Jones, M. D.

W. R. Johnson,

M. W. Baldwin,

James P. Espy,

George Merrick.

Immediately after their appointment, the Committee addressed a circular letter to persons, whom they supposed would be able to give information, in regard to the explosions of steam-boilers which had occurred in our country, or abroad, and of which no accounts had been previously published. They took, also, other means to inform themselves on the subject referred to them.

The information derived from replies to the circular has already been made public.†

While the Committee were engaged in the inquiries necessary to enable them to report to the Managers of the Franklin Institute, a letter was received by that body from the Secretary of the Treasury of the United States, informing them that funds had been placed, by the House of Representatives, at the disposal of the department, for inquiries in regard to the explosions of steam-boilers, and inviting experiments on the subject, by the Institute, at the expense of the Treasury Department.

A series of questions, connected with the probable causes of explosion, or with theories which have been offered in relation to them, and with the safety of the steam engine, was submitted to the Secretary of the Treasury, with a plan of experiment based upon the queries, and an estimate of the cost of the experiments. This plan was approved, and authority given to add to the original subjects proposed for investigation, any others which might suggest themselves in the course of the experiments; the amount to be expended being, however, limited.

\* This resolution was moved by W. H. Keating, Esq., who subsequently declined the chair of the Committee, and Prof. A. D. Bache was chosen chairman.

† Journal Franklin Institute, vols. viii., ix., and x.

In order to carry on the experiments, the following sub-committees were appointed.

1. On the experiments,\* excepting those relating to the strength of iron and copper.

Messrs. A. D. Bache,	M. W. Baldwin,
Benjamin Reeves,	S. V. Merrick,
W. H. Keating,	Isaiah Lukens.

2. On the strength of iron and copper used for steam-boilers.†

Messrs. W. R. Johnson,
A. D. Bache,
Benjamin Reeves.

The first of these sub-committees presented the report of their experimental investigations, which, having been examined by the Committee, was finally adopted on the 23d of December, 1835, and ordered to be submitted, through the Managers of the Institute, to the Secretary of the Treasury.

The labours of the second sub-committee, as well as a report on the subjects in relation to which the Committee was appointed, yet remain to be presented.

It was deemed proper to delay such a report, until all the light which the experiments could afford, had been shed upon the important and intricate subject referred to the Committee.

On behalf and by direction of the Committee, &c.

ALEX. DALLAS BACHE, *Chairman.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Account of the Explosion of the Boiler of the Steamboat Wm. Gibbons.* By THOMAS EWBANK, of New York.‡

This explosion occurred on Thursday morning, January 21st, as the boat was entering this harbour, on her return from Charleston, (S. C.) By this melancholy disaster, six lives have been lost.

The Wm. Gibbons has but one boiler, made of wrought iron, and similar in its construction to those of the "Ohio," and "New England," but having a greater number of horizontal flues. These terminate, as in the boilers of those boats, in a large vertical flue, which passes through the roof of the boiler. It was this flue which was collapsed. The following memoranda were made by me on different visits to the boat.

*January 24.* I visited the Wm. Gibbons this day. The chimney proper, or smoke pipe, (represented by the dotted lines, *a, a*, in the annexed sketch, Plate XVII., Fig. 1,) had been removed. Upon looking down, the collapse was quite obvious. The flue was pressed together, so as to be closed almost entirely at the part where the rent had taken place. A section of

\* This sub-committee had the subjects referred to them on the 1st of November, 1830.

† Appointed January 4th, 1831.

‡ This interesting account was addressed to the Committee on Explosions, in consequence of a request made to Mr. Ewbank by a member of that Committee. We feel persuaded that if intelligent men at the different places near which explosions occur, would take pains to ascertain the nature of the effects, and make public the results of their examinations, the cause of humanity would be essentially served. It will be seen that Mr. Allaire, the maker of the boiler of the Wm. Gibbons, has set a most praiseworthy example, by affording every facility for examining the effects of the explosion.

that part is represented at F, Fig. 2, exhibiting a three cusped figure, instead of that of a circle, its original form. As the flue was still enclosed in the case B, the precise situation of the rent with respect to the surface of the water in the boiler, could not then be accurately ascertained, without entering the boiler. The collapsed flue is made of quarter inch iron, and is three feet in diameter. A space of seven inches is left between it and B. The steam pipe, S, is connected to the latter at its upper end, which is eight feet above the roof of the boiler.

*January 26.* This day B was removed, leaving the ruptured and vertical flue, C in the sketch, fully exposed to view. The rent, R, was four inches above the roof of the boiler. It was in one of the horizontal seams, and confined almost wholly to it; it extended nearly three feet, or about one-third of the circumference. The line of separation was through the centre of the rivet holes, nearly the whole extent, a strip of metal thus separated being left in its place, in the lower portion of the flue. The iron is cracked in some places, where the flexure has been greatest, as at O.

Through the politeness of James P. Allaire, Esq., the builder of the engine and boiler, and also one of the owners of the boat, I have obtained a portion of the ruptured flue, which is sent with this communication. It is from one end of the rent. The thickness of the metal at the part ruptured is not sensibly diminished, as will be perceived by the specimen sent. The question of the deterioration of the metal by heat, may perhaps be determined by it also.

The original cause of this explosion is conceived to be identical with that of the Ohio,\* and is to be found in the "construction of the boiler," the arrangement of the flues in it being such that the principal one, (that which collapsed,) could not be protected by the water. Its exposure to high degrees of temperature, under these circumstances, must necessarily diminish its strength very materially. The increase of its temperature is also accompanied with an increased elasticity of the steam; hence its power of resisting the pressure around it diminishes as that power is augmented.

In addition to the remarks made on these flues in the case of the Ohio, it may be further observed, that, from their greater dimensions compared with the horizontal ones, their strength necessarily bears no comparison with that of the latter, even if covered, like them, with water. How much more liable to destruction, then, are they, wholly unprotected by it? The horizontal flues of the Wm. Gibbons do not exceed twelve inches in diameter; the ruptured flue, as before observed, is thirty-six inches.

If steam chimnies are deemed indispensable, would it not be safer to convey each horizontal flue separately through the roof of the boiler, than to combine them all in the large one in question?

The surest remedy, however, is to make all interior flues terminate outside of the boiler, *below* the water line. Neither this explosion, nor that of the Ohio, could have occurred, if such had been the arrangement in their respective boilers.

The immediate cause of the explosion is attributed, and no doubt justly, to the imprudence of the second engineer, and two of the firemen,† in wantonly urging the fire with quantities of wood, (anthracite coal being the principal fuel used,) and thus unnecessarily, at that time, increasing the force of the steam, and the heat of the vertical flue, against the positive and

\* See this Journal, vol. x., p. 226, Ewbank on the Explosion of the Steamboat Ohio. The effects on the boiler, in that case and this, are strikingly similar. COM. PUB.

† They were all killed.

repeated directions of the chief engineer, who was very unwell at the time. It appears that one or more of them ridiculed the apprehensions of that officer, while in this act of disobeying his orders. His reasons for giving such directions are not left to conjecture, when we learn that, off Cape Hatteras, he had discovered that the vertical flue was pressed inwards, in one place, although but slightly. This is the fact referred to by one of the passengers, (Mr. Newmark,) in the statement which follows. The repairs done to the boiler, near Cape Hatteras, were in consequence of a leak near one of the fire doors.

The engine and boiler were considered in good repair; there was no design to repair either previous to the next trip, as has been stated in some of the papers. The only alterations contemplated were in the paddles, which they are now undergoing.

The following statement of a number of the passengers who were on board of the William Gibbons, was published just subsequent to the explosion.

*To the Public.*

The undersigned, passengers on board the steam packet Wm. Gibbons, on the occasion of her late disastrous trip from Charleston to this port, convinced that no adequate account has yet been given to the public of the circumstances connected with the explosion, by which six unfortunate individuals were hurried away in all the vigour of life, feel it to be their duty to submit to the community a concise statement of certain facts within their personal knowledge. Events so calamitous, however great the individual anguish of which they are the occasion, may, nevertheless, be the source of some public good; but this good can spring only from a development of all their attendant circumstances, to such an extent that they may constitute a warning and a lesson for the future.

The Gibbons left Charleston on the morning of Sunday, the 17th of January, at 10 o'clock. On Monday, about sunset, she passed Cape Hatteras. Not long afterward, the engine was stopped, the fires extinguished, and the water discharged from the boiler. The whole night was consumed in repairs, with the precise nature of which we were, at the time, unacquainted. The inquiries of the passengers failed to elicit any satisfactory information; there seemed, indeed, to exist a studied determination, on the part of those in authority on board, to avoid making any disclosures.

After this time we carried very low steam, the gauge rod not standing generally higher than seven, eight, or nine inches. Before reaching Cape Hatteras, it had stood usually at fifteen, sixteen, or eighteen. Being in plain sight, it was frequently noticed, for many of the passengers were suspicious of our danger, and mentioned their apprehensions repeatedly.

On Thursday morning, it was remarked that we were again carrying heavy steam, a circumstance which had not been before observed since the occurrence at Cape Hatteras. A gentleman who was standing near the steam chimney, for the purpose of warming himself, called the attention of another to the fact that the rod stood at fifteen inches. This was mentioned to several, who observed that our speed indicated high pressure. These gentlemen believe that not more than ten or fifteen minutes had elapsed after this observation, before the explosion took place. In order, however, to be perfectly safe, they are willing to testify that the time was not greater than half an hour; our speed, meanwhile, by no means indicating a diminished power. Let this be compared with the statement which has been given to the public, that, at the moment of the accident, the rod stood at

nine inches. At the *very* moment of the accident, what was the pressure. Heaven only knows; but that an explosion could have taken place from the expansive force of steam at a pressure of nine inches, in less than half an hour after a pressure of fifteen had been endured without accident, is a supposition not remarkably plausible.

On the morning of Thursday, the day of the accident, between one and two o'clock, the first engineer was heard to caution his assistant, to whom at that hour he committed the charge of the engine, against getting up the steam too high, making use of the expression, "she will not bear (or carry) much steam." An unusual sound was soon after heard, described by a passenger as resembling the wheezing of a wind-broken horse, which was believed to be occasioned by the escape of steam through an irregular channel. After daylight another sound was noticed, like what might be occasioned by the dripping of water upon coals. It may be inquired whether this sound did not attract the attention of the captain himself, when in the forward cabin, between seven and eight o'clock in the morning, and whether he did not then approach the end of the boiler to ascertain the cause.

The undersigned choose not to allude to matters of common belief in the community, but to which their personal knowledge does not extend. They are persuaded, however, that a judicial investigation would demonstrate that the boiler of the Wm. Gibbons had been deemed unsafe antecedently to this last unfortunate trip, and the accident we have now to deplore, was not the first intimation of its insecurity received by the owners. If it be true that the Gibbons was not intended for another trip before receiving repairs, the fact ought to be known. This boat was sent out in the room of the Columbia, which had been advertised at the other end of the line, but was not despatched, in consequence, it is said, of the incompleteness of her preparations.

The object of the undersigned is not to inculcate any one; if blame is anywhere due, the public, in view of the circumstances, will apply it to the right quarter. If no one is blameable, the facts will show this likewise; and the statement now made, being truth, and nothing but the truth, will acquit of groundless suspicion all who might otherwise suffer.

In cases like the present, where human life is endangered, or destroyed, too much light cannot be thrown upon the causes; too great watchfulness cannot be exercised to vindicate those, through whose instrumentality, though it be indirect, though it be but an error of omission, or of carelessness, the happiness of families is thus broken up, and the hearts of parents, of sisters, and of relations yet more near, are wrung with anguish.

It was not the original intention of the undersigned to make any public statement on this subject. The imperfect statements which have appeared in regard to it, have, however, induced them to the present course. The passengers of the Gibbons are now, in a great measure, dispersed. The names which follow, are those of all whom it has been found practicable to see.

Frederick A. P. Barnard,	New York.
James M. Dowall,	Augusta, Ga.
C. B. Seymour,	Roanoke, Ga.
Samuel K. Tallmadge,	Augusta, Ga.
O. E. Carmichael,	" "
Robert D. Hamlin,	" "

D. B. Nafew,	New York.
William Swift,	"
John F. M'Kinne,	"
Robert Cochrane,	"
Isaac Sniffen,	"
Charles Elms,	Charleston, S. C.
Joseph Newmark,	84 Murray street, New York.
E. Robbins,	New York.

The following fact, in addition to the above, may be stated by the subscriber. On Monday afternoon, before the occurrence at Cape Hatteras, I observed one of the engineers to open the sheet-iron door looking into the steam chimney, and afterwards to go down, and return in company with the other. After examining it together, one remarked to the other, "I think there will be no danger till we get to New York." This fact I stated to the coroner's jury on the body of Mr. Davega, in the presence of the captain and first engineer.

JOSEPH NEWMARK,  
84 Murray street.

It is but fair to state, before concluding these remarks, the alleged advantages of steam chimnies. The following experiment is furnished by Mr. Allaire, as a case in point. His extensive experience, and long practice, together with the great facilities he possesses in his establishment for experimenting on a large scale, entitle his views to more than ordinary consideration.

A common boiler was found to generate steam so very slowly as to be almost useless; it was with difficulty that the steam could be maintained in it at seven pounds to the inch. A steam chimney was afterwards adapted to it, when the steam was with less trouble kept up to fifteen pounds.

It is said that there is no danger in steam chimnies, provided the steam is permitted to escape through the safety valve, which is placed on the steam pipe, *whenever the engine is not in motion*, as when the boat is in the dock, previous to starting, &c. The object of this is, to prevent the vertical flue above the surface of the water becoming unduly heated, for the steam, by passing up round it, carries off the caloric from its surface, and thereby tends to keep its temperature at the same range as that of the steam, or nearly so. The great source of the destruction of these flues, is said to be the neglect of this precaution. Some have been destroyed in a few weeks from this cause, while others have lasted for years. To prevent, however, their destruction, in future, from this source, Mr. Allaire is now lining them with fire-brick, which, it is supposed, will combine their peculiar advantages with perfect safety.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Plan for a new Pump for Feeding Steam Engine Boilers, &c.* By CHARLES POTTS, Civil Engineer.

Having had occasion, some years ago, to construct a small steam engine, with a view to make a few experiments in dynamics, and being desirous to make all the parts of my engine in the most simple and easy manner, having the least quantity of work about them, I fell upon the following plans for introducing water into the boiler. As I believe there is something in this contrivance worthy the attention of the mechanician, and that it may, in many instances, be substituted with advantage for the ordinary pump, I am desirous

of submitting it to the public, through the medium of your scientific journal. Before describing the plans, as exhibited in the drawing herewith presented, it may be well to premise, that the water intended to supply the boiler, is caused to flow therein by gravitation. Hence, it will be necessary, in all cases, that the water wherewith the boiler is to be fed, together with the apparatus herewith described for feeding, should be elevated above the level of the top water line of the boiler. Thus, in Fig. 3, Plate VII., C, D, represents the boiler of a steam engine, with the feeding apparatus, or pump, connected with it, and above it. In this figure, the feeding apparatus, or pump, in its general construction, very much resembles a common plug-cock. Fig. 4 exhibits another view of it; in both figures, the same letters of reference denote similar parts. A, B, is the plug, which is to be made *hollow*, as in Fig. 3, and to have its exterior surface turned true, and made to fit steam-tight into the shell, or casing, H, I. This casing is cast with two flanches upon it, one above, as *m, n*, and one below, as *s, t*; each flanch having an opening, *o, o*, through it. There is also an opening in the plug, as shown at *w*, Fig. 3.

During the operation of feeding, the plug, A, B, is caused to revolve around in its seat; this may be done by placing a pulley upon its axis, as shown at P, fig. 4, and strapping it from any convenient part of the engine. In order to show the operation of this machine more clearly, I have supposed a water tank, K, L, to be placed directly upon the upper flanch, with a pipe and ball cock from the *water pipes in the streets*, to supply it with cold water. The operation of this pump will be as follows: When the engine is put in motion, and, consequently, the plug, A, B, the opening, *w*, in the plug, will be brought round to the position shown in Fig. 3; in this position, the cold water from the tank above will *descend into the hollow or cavity* in the plug; but as the plug revolves, when the opening, *w*, has passed the opening in the upper flanch, the connection with the tank will be cut off; and when the opening, *w*, moves round, and comes over the opening in the lower flanch, the water from the plug will descend, and pass down the tube into the boiler, C, D. It will be obvious to the mechanician, that the quantity of water passed into the plug in one revolution, may be regulated in several ways, either by enlarging the opening into the plug, or by giving the plug a quicker, or slower, motion, at the time the openings are in juxtaposition.

To equalize the pressure above and below the water in the hollow of A, B, a small pipe, or channel, *x, y*, is made to the casing, H, I, whereby the steam passes up to the opening, *y*, in the casing; and when the opening, *w*, of the plug, is over the lower opening to the boiler, the small hole, *z*, will be in connection with the opening, *y*, so that the steam is then admitted into the top of the hollow of the plug, and the water in the plug will descend freely by the force of gravity. A similar opening may be contrived for the free admission of the water from the tank into the plug.

Having now described this pump, I shall make a few remarks in reference to what I conceive to be its advantages. And first: We have here an apparatus which will perform all the functions of a forcing pump, without valves. Secondly. The only resistance in the working of this pump, will arise from the friction of the exterior surface of the plug against the casing, as it revolves. And thirdly. It is a sure and certain regulator for the supply of water to the boiler. The first two items above mentioned are so obvious, that it were needless, perhaps, to comment upon them; the latter item, however, may not be quite so apparent. I will, therefore, show how the pump may serve

as a *regulator*. The feed-pipe,  $u v$ , must be connected with the boiler at the top water line, as E, E. Now, if the pump supplies water faster than it is evaporated, and the top water line, E, E, rises so as to cover the opening of the pipe, the pipe would be filled with water, instead of steam, and, consequently, the water in the plug, A, B, could not descend. When, however, the top water line, E, E, of the boiler, descended below the opening of the pipe,  $w, v$ , the pump would again operate to supply the boiler. In this manner, it would work so that, if properly adjusted in the first instance, the water in the boiler would always be continued at its proper height. It will be seen that, every time the pump, or plug, A, B, discharges its contents into the boiler, the chamber of the plug becomes filled with steam, and will be allowed to pass off and condense, when the opening of the plug connects with the tank. This process, it must be evident, will be an advantage, rather than otherwise, as much of the caloric of the steam will thus be imparted to the water, previous to its passing into the boiler. I have preferred describing the above apparatus, as it is the most simple in its construction, and, therefore, more easily to be understood. The same end, however, may be effected by a very different arrangement, as will be seen by reference to Fig. 5. Here, A, B, represents a *hollow plunger*, being turned smooth and true on its exterior surface, and made to work up and down through two stuffing boxes, E and F, placed on the ends of the hollow cylinder, or box, C, D. The plunger has three openings,  $o, p, q$ , (or it may be one long slit from  $o$  to  $q$ ,) for the purpose of allowing the water to flow into and out of the chamber, C, D, through the hollow plunger; the small tube, or channel,  $r, s$ , is to allow the steam to enter at the top of the chamber, C, D, in order that the water may flow freely out from the chamber into the feed-pipe,  $v$ . If we suppose the water tank, K, L, Fig. 3, to be placed on the flanch,  $t, u$ , Fig. 3, and the plunger, A, B, to be connected with the engine, so as to be caused to move up and down, as the plunger of the ordinary forcing pump, it will be perceived that, when the plunger is up, the hole,  $o$ , will be within the tank, and the hole,  $q$ , within the chamber, C, D; hence, water from the tank may flow in and fill the chamber, C, D; and when the plunger is down, as is represented in the figure, the hole,  $q$ , will be open to the boiler, and the water in the chamber will descend, through  $p$  and  $q$ , into it. The relative diameters of the plunger, and that of the chamber, C, D, may be varied to suit the motion which is given to the plunger.

*Philadelphia, February, 1836.*

P. S.—I am aware that, in the practical operation of the above described pumps, some difficulties will probably occur, but I am fully persuaded that they are not insurmountable. Thus, for instance, when the pump is designed to regulate the quantity of water to the boiler, as it would be necessary to have the connection of the feed-pipe with the boiler near the top water line, the water from the boiler would frequently rise in the tube, and run up to the pump before the body of water in the boiler had risen to cover the opening of the feed-pipe. This difficulty would be remedied by a small tube from the top of the boiler, Fig. 3, to the opening,  $y$ , in the casing of the pump.

## Physical Science.

*Remarks on a Method, proposed by Doctor Thomson, for Determining the Proportions of Potassa and Soda in a Mixture of the two Alkalies, with the application of a similar investigation to a Different Method of Analysis.*  
By A. D. BACHE, Professor of Natural Philosophy and Chemistry, University of Pennsylvania.

In a recent number\* of the "Records of General Science," Doctor Thomson gives the following method of determining the proportions of potassa and soda in a mixture of the two alkalies. The method is accompanied by an example of its use.

"1. Convert the mixture of potash and soda into sulphates, render these sulphates anhydrous by ignition in a platinum crucible, and determine their weight. Let it amount to 29 grains.

"2. Dissolve the two sulphates in water, and throw down the sulphuric acid by chloride of barium. Wash the sulphate of barytes obtained, dry it and weigh it after ignition. Let the weight be 43.5 grains, indicating 15½ grains of sulphuric acid.

"3. Separate any excess of barytes that may have been added to the liquid, by the cautious addition of dilute sulphuric acid. Filter, evaporate to dryness and ignite. The salt thus obtained will consist of the mixture of potash and soda converted into chloride of potassium and sodium. Weigh this salt. Let the weight be 24.5 grains."

"Now the atom of potash is 6, and that of soda 4: and it is obvious from paragraphs 1 and 2 that the mixture of potash and soda will weigh 14."

"Let the [number of] atoms of potash in the mixture be  $x$ , and those of soda  $y$ , it is plain that we have:

$$6x + 4y = 14, \text{ and } x = \frac{14-4y}{6}$$

"By comparing paragraphs 2 and 3, it is obvious, that the weight of the chlorine in the 24.5 grains of the mixed chloride obtained is 13.5 grains. For it must be equivalent to the 15 grains of sulphuric acid. In this mixed chloride the potash is converted into potassium, and consequently its atom only weighs 5, while the atom of sodium weighs 3. We have therefore

$$5x + 3y + 13.5 = 24.5 \text{ and, } x = \frac{11-3y}{5}$$

If we equate these two values of  $x$ , we have

$$\frac{14-4y}{6} = \frac{11-3y}{5}$$

By solving this equation we obtain  $y = 2$ . From which we deduce  $x = 1$ .

Thus it appears, that in the supposed mixture there were 6 grains of potash and 8 grains of soda."

\* January, 1836. On the Method of Determining the Proportions of Potash and Soda, when the two Alkalies are mixed together. By Thomas Thomson, M. D., F. R. S. L. and E., Regius Professor of Chemistry in the University of Glasgow.

† The equivalents of baryta and sulphuric acid are here assumed as 76 and 40 respectively, referring them to the hydrogen unit.

Now it seems to me that the third step in the analysis, namely that contained in paragraph 3, is unnecessary, all the numbers required for the calculation having been obtained by the first and second steps.

By the first step we obtain the weight of the mixed sulphates; by the second the amount of sulphuric acid present, whence results the weight of the mixed alkalies. But incidentally we have obtained the quantity of oxygen present in the mixed alkalies; for the chloride of barium and the sulphates of potassa and soda have by their reaction formed sulphate of baryta, and chlorides of potassium and sodium. And the oxygen of the baryta in the sulphate of baryta, is equal to the oxygen of the two alkalies. Subtracting this from the weights of the alkalies we have, without the necessity for the third step proposed by Doctor Thomson, the weights of the metals. These weights furnish his second equation.

In the example referred to, we have found by comparing paragraphs 1 and 2, the weight of the mixed alkalies to be 14, whence calling  $x$  and  $y$  the unknown number of equivalents of the potash and soda respectively, resulted the equation

$$6x + 4y = 14, \text{ and thence } x = \frac{14-4y}{6}$$

From the second paragraph the weight of sulphate of baryta obtained is given 43.5 grains; whence using the same equivalents as Doctor Thomson has employed, the baryta is found to be 28.5 grains, of which 25.5 grains is barium and 3 grains oxygen. Deducting this oxygen, which belonged to the alkalies, from the weight of the mixed alkalies, we have 11 grains for the weight of the metals, and the second equation given by Doctor Thomson.

$$5x + 3y = 11, \text{ or } x = \frac{11-3y}{5}$$

It is plain that these remarks will be true if the nitrate of baryta should be substituted for the chloride of barium in obtaining the quantity of sulphuric acid present; for the quantity of oxygen in the baryta of the precipitated sulphate, will always be equal to that in any protoxide, or protoxides, saturating the same weight of acid.

The third step in the proposed analysis is therefore superfluous, unless used as a means of verification.

I propose now to obtain, as Doctor Thomson has done, in the sequel of his paper, general equations for calculating the weights of the alkalies from the analysis, omitting only a reference to the third step, which has been shown to be unnecessary. As algebraic notation is repulsive to some who may chose to refer to this method of analysis, I will endeavour finally, to prove the results by arithmetical processes, and to point out a simple method of calculation.

It seems to me more convenient to determine the absolute weights of the alkalies from a formula, rather than the number of equivalents.

Let  $v$  be the weight of the potassa in the mixture;  $z$  that of the soda. Let  $m$  be the weight of the mixed sulphates obtained as stated in paragraph (1), and  $n$  the weight of the sulphate of baryta obtained as in paragraph (2), then using 76\* as the weight of the equivalent of baryta, and 116 as that of sulphate of baryta, the baryta in  $n$ , will be  $\frac{19}{29}n$ ; and the oxygen

\* I have used throughout the equivalent numbers given by Doctor Thomson in the seventh edition of his System of Chemistry, in order to preserve uniformity in the results.

contained in this baryta will be  $\frac{2}{29} n$ . But the oxygen in  $v$  grains of potassa is  $\frac{v}{6}$ , and in  $z$  grains of soda is  $\frac{z}{4}$ , and since the oxygen in the alkalies is equal to that in the baryta,

$$\frac{v}{6} + \frac{z}{4} = \frac{2}{29} n, \text{ or } 58 v + 87 z = 24 n \dots (a.)$$

Again, the sulphuric acid in  $n$  grains of sulphate of baryta is  $\frac{10}{29} n$ , therefore the alkalies in the mixed sulphates (1) will be  $m - \frac{10}{29} n$ ; that is

$$v + z = m - \frac{10}{29} n = \frac{29m - 10n}{29},$$

$$\text{or } 58 v + 58 z = 58m - 20n \dots (b.)$$

combining this equation with (a.) we find  $z = \frac{44n - 58m}{29}$ , and,

$$v = \frac{87m - 54n}{29}.$$

These formulæ lead to the following rules, the analysis having been made as described.

1st. For the weight of the soda. From 44 times the weight of the sulphate of baryta (2), take 58 times the weight of the mixed alkaline sulphates (1) and divide the difference by 29.

2d. For the weight of the potassa. From 87 times the weight of the mixed sulphates (1) take 54 times the weight of the sulphate of baryta (2), and divide the difference by 29.

In the example referred to by Doctor Thomson,  $m = 29$  and  $n = 43.5$ , whence,

$$z = \frac{44 \times 43.5 - 58 \times 29}{29} = \frac{1914}{29} - 58 = 8; \text{ and } v = \frac{87 \times 29 - 54 \times 43.5}{29} = 6 \text{ grains.}$$

The following arithmetical process may be substituted for the algebraic one.

Having found the weight of the mixed alkaline sulphates (1) and the sulphuric acid which they contain (2) the weight of the mixed alkalies is known.

The oxygen which these mixed alkalies contain is known, being equal to that of the baryta in the precipitate of sulphate of baryta (2), or  $\frac{2}{29}$ ths of the weight of that sulphate.

Potassa contains  $\frac{1}{6}$ th ( $\frac{2}{12}$ ths), and soda  $\frac{1}{4}$ th ( $\frac{3}{12}$ ths), of its weight of oxygen. The oxygen of the mixed alkalies, found as just stated above, is equivalent to  $\frac{2}{12}$ ths of the weight of the potassa, and  $\frac{3}{12}$ ths of the weight of the soda; that is to  $\frac{2}{12}$ ths, or  $\frac{1}{6}$ th of the weight of the mixed alkalies, together with  $\frac{1}{12}$ th of the weight of the soda. Therefore taking from the weight of the oxygen in the mixed alkalies,  $\frac{1}{6}$ th of the weight of the alkalies themselves, the remainder will be  $\frac{1}{12}$ th of the weight of the soda.

From which is deduced a very simple rule.

*Find, from the steps of the analysis, the united weights of the alkalies, and the weight of the oxygen which they contain. Take  $\frac{1}{6}$ th of the former weight from the latter, and multiply the difference thus found, by twelve. The result will be the weight of the soda. Subtract this from the weight of the mixed alkalies, the remainder will be the potassa.*

To apply this to the example in which the weight of the mixed sulphates is 29, and of the sulphate of baryta, equivalent to their acid, is 43.5 grains.

43.5 grains of sulphate of baryta contain 15 of sulphuric acid. The united weights of the alkalies is therefore 14;  $\frac{1}{3}$ th of which is  $2\frac{1}{3}$ . The oxygen of the baryta, in 43.5 grains of the sulphate of baryta, is 3 grains. Taking  $2\frac{1}{3}$  from three we have  $\frac{2}{3}$ ds, which multiplied by 12 gives 8 grains for the weight of the soda. This taken from 14 leaves 6 grains for the weight of the potassa in the mixture.

At the suggestion of my friend, Professor H. D. Rogers, I am induced to extend the foregoing method of calculation to the usual way of determining the quantities of the alkalies by their conversion into the chlorides of their metallic bases, avoiding the ordinary step which requires their separation by the use of chloride of platinum, by determining the chlorine in the mixture, by nitrate of silver.

(A) The alkalies are to be converted into muriates, if not already in that state, by the ordinary steps of mineral analysis. These being evaporated to dryness, ignited and weighed, will give the amount of chlorides of potassium and sodium which are present.

(B) Dissolve the mixed chlorides in water acidulated with nitric acid. Nitrate of silver will throw down the chlorine, and by treating the precipitated chloride of silver in the usual way, the quantity of chlorine is deduced from the weight of the fused chloride.

To calculate the weights of the alkalies; let  $v$  and  $z$  represent the weights of the potassa and soda respectively;  $c$  the weight of the mixed chlorides (A), and  $d$  that of the chloride of silver (B). Using 146 as the equivalent of chloride of silver,  $d$  grains of the chloride contain  $\frac{1}{7}\frac{8}{3}d$  grains of chlorine; the weight of the metals in the mixed chlorides (A) is therefore  $c - \frac{1}{7}\frac{8}{3}d$ . But  $v$  grains of potassa contain  $\frac{5}{6}v$  of potassium, and  $z$  grains of soda,  $\frac{3}{4}z$  of sodium. Whence  $\frac{5}{6}v + \frac{3}{4}z = c - \frac{1}{7}\frac{8}{3}d$ .

The oxygen contained in the mixed alkalies is  $\frac{8}{36}$ ths, or  $\frac{2}{9}$ ths of the chlorine in the chlorides of their metallic bases, or is  $\frac{2}{9}$ ths of  $\frac{1}{7}\frac{8}{3}d$ , or  $\frac{4}{73}d$ . And as  $v$  grains of potassa contain  $\frac{1}{6}v$  grains of oxygen, and  $z$  grains of soda,  $\frac{1}{4}z$  grains of oxygen, we have a second equation containing  $v$  and  $z$ ;  $\frac{1}{6}v + \frac{1}{4}z = \frac{4}{73}d$ , or  $\frac{5}{6}v + \frac{5}{4}z = \frac{20}{73}d$ . Combining this with the equation obtained above,  $z = \frac{76}{73}d - 2c$ , and  $v = 3c - \frac{90}{73}d$ .

Whence result the following simple rules.

*To obtain the soda from the method of analysis stated above, from  $\frac{76}{73}$ rd of the weight of chloride of silver (B), take twice the weight of the mixed chlorides (A).*

*To obtain the potassa. From three times the weight of the mixed chlorides (A), take  $\frac{90}{73}$ rd of the weight of the chloride of silver (B).*

To apply this to the example before discussed, suppose the weight of the mixed chlorides to be 24.5 grains, and of the chloride of silver 54.75 grains. From  $\frac{76}{73}$ rd of 54.75, or 57, take thrice 24.5, or 49, the remainder, 8, will be the grains of soda in the mixture.

From three times 24.5, or 73.5, take  $\frac{90}{73}$ rd of 54.75, or 67.5, the remainder, 6 grains, will be the potassa.

An equally simple method of calculation may be obtained without resort to algebra. By the second step of the analysis the chlorine in the mixed chlorides, of the metallic bases of the alkalies, is obtained, being  $\frac{1}{7}\frac{8}{3}$ rd of the weight of the chloride; subtracting this from the weight of the mixed chlorides obtained by the first step, we have the weight of the metallic bases. Taking  $\frac{2}{9}$ ths of the weight of the chlorine, we have the oxygen re-

quisite to form the alkalies. Potassa contains  $\frac{1}{6}$ th, and soda  $\frac{1}{4}$ th of the weight of oxygen;  $\frac{5}{8}$ ths of the potassa and  $\frac{5}{4}$ ths of the soda, will be equal in weight to five times the oxygen, the weight of which has just been obtained. But potassa contains  $\frac{5}{8}$ ths of its weight of potassium, and soda  $\frac{3}{4}$ ths of its weight of sodium, and the united weights of these metals has also been obtained as above. Taking this latter sum from the former we find that *one half the weight of the soda is equal to five times the oxygen less the weight of the metals. One sixth of the weight of the potassa is equal to the weight of the oxygen, less one fourth the weight of the soda.*

Resuming the example before employed, in which the weight of the mixed chlorides is 24.5 grains, and of the chloride of silver 54.75 grains. The chlorine in 54.75 grains of chloride of silver is 13.5 grains. Subtracting this from 24.5 grains, we have 11 for the weight of the metallic bases of the alkalies. The oxygen equivalent to 13.5 grains of chlorine is 3 grains.

By the rule,  $5 \times 3$  or 15, less 11, the weight of the metals, is half the weight of the soda; the soda is, therefore, 8 grains. The weight of oxygen, 3 grains, less one fourth of the soda, 2 grains, gives one sixth of the weight of the potassa. The potassa is therefore 6 grains.

It is readily seen that the general principle to which these results refer themselves, may be used with great effect in avoiding a difficult step in chemical analysis, by the substitution of a less direct, but more simple one, aided by easy calculations.

This problem is only a particular case of a general one, well deserving the attention of analytical chemists.

*Essays on Meteorology.* By JAMES P. ESPY, Mem. Am. Philos. Soc., &c.

No. II.

### *Theory of Hail.*

On the principles established in the first essay, the spout, which is nothing but visible condensed vapour, may sometimes not reach entirely down to the surface of the earth, or sea, when the dew-point is too low for such an effect; in this case, it will appear as an inverted cone, reaching down from a cloud already formed.

It may here be observed, that a spout will always begin to be formed at a considerable elevation above the surface of the earth, because the vapour will always begin to condense there, from a law too well understood by meteorologists to need elucidation here. When, however, it begins to condense, it begins, also, by its diminished specific gravity, to rise, and then, if all circumstances are favourable, the cloud will increase as it ascends, and finally become of so great perpendicular depth, that, by its less specific gravity, the air below it, and contiguous to it, in consequence of diminished pressure, will so expand, and cool by expansion, as to condense the vapour in it; and then the air below this again, will, in its turn, experience a greater and greater expansion and refrigeration, and, consequently, condensation of vapour; and this process may go on so rapidly, that the visible cone may appear to descend to the surface of the sea, or earth, from the place where it first appears, in about one or two seconds.

The terms here employed must not be understood to mean that the vapour, or cloud, actually descends; it appears, to the spectator, to descend, but this is an optical deception, arising from new portions of invisible va-

pour constantly becoming condensed, while, all the time, the individual particles are in rapid motion upwards.

For the sake of illustrating the principle, without aiming at absolute numerical accuracy, let us suppose a dew-point ten degrees below the temperature of the air. Now, a diminished pressure of one pound to the square inch, will cause a fall of temperature of only six degrees, so that, in this case, the visible cone would not reach down to the surface of the earth, or sea, and the air would have to ascend a little more than 400 yards, before condensation would commence. I say *more* than 400, because, though the temperature sinks one degree for every hundred yards of elevation, the dew-point also sinks a little from the expansion of the air, and the same quantity of vapour occupying a larger space. But, if the dew-point in the above case had been only six degrees below the temperature of the air, then the spout, or visible cone of vapour, would have reached the earth.

Now, it is highly probable that a spout, in passing over the surface of the earth, would meet with slight variations in the dew-point, and, if so, it would rise as the dew-point fell, and fall as the dew-point rose; and thus the theoretical deductions correspond exactly with the facts.

Again, the direction of the two spouts, as also of the great storm with two veins of hail, mentioned in a former essay, was from the south-west to the north-east; and Pouillet says, that a large majority of these storms are known to move in this direction. I presume he means those which occur in France. Now, it is manifest that these storms, according to the theory, must move in the direction of the upper current into which they may ascend, for the top of the vortex will lean in that direction; and, as theory demonstrates, and observation agrees with that demonstration, that the uppermost current of air in the temperate zone moves constantly from the south of west, towards the north of east, this will satisfactorily account for the general tendency of these storms in that direction, all over the northern temperate zone, or, at least, above lat. 30°. For, from that latitude, down to the tropic of Cancer, the uppermost current of air moves nearly towards the north, and, within the tropic, it moves towards the north-west; and so the theory would lead us to presume that, in these regions, the storms will be found to move in these directions. Such is shown to be the fact by Mr. Redfield, as to all great storms which travel any considerable distance in the West Indies. And in the *Philosophical Transactions*, Lathrop's Abridgement, vol. 2, p. 107, it is said that hurricanes in the West Indies begin from the north-west, and terminate with a south-east wind.

It is quite reasonable to suppose that these spouts sometimes meet with a middle current, moving in a different direction from the uppermost, which will account for the exceptions to the general rule; for the spouts will, in such case, certainly lean, and, of course, move, in the direction of the middle current.

These three storms all occurred in the day, and two of them in the afternoon; and M. Pouillet says that many more occur in the day than in the night. Now, this is precisely what the theory would lead us to suppose, and the explanation of this fact affords me an opportunity of explaining the very commencement of those spouts which occur during the day. The sun, during the day, and especially in the afternoon, heats up the surface of the earth, and the air in contact with that surface, many degrees above the air, a few hundred feet above the earth. This heated air below, and cold air above, will form an unstable equilibrium, and a very slight agitation will cause to be formed upward vortices of the light air below, and

downward vortices of the dense air above. Now, if the dew-point is not more than ten degrees below the temperature of the air in contact with the soil, the air of the upward vortex will not ascend much above one thousand yards, before the refrigeration, caused by expansion, will cause a beginning of condensation of vapour; and the moment this occurs, the velocity of upward motion is rapidly increased, from the expanding effect caused by the evolution of latent caloric, as before explained.

If the dew-point of the air at this elevation should be almost identical with its temperature, the cloud of the upward vortex will go on increasing in size and perpendicular height, until the air immediately below it, being pressed downwards with less and less weight as the cloud above increases in height and levity, will, by expanding more than the air which preceded it in the vortex, be cooled down to the point of deposition, before it reaches the elevation of one thousand yards. And if, in this case, the vortex should rise to a height sufficient to produce a diminution of pressure under it of one pound to the square inch, the cone of visible vapour, or cloud, will reach down to a point four hundred yards from the earth's surface. And, in general, the nearer the dew-point is to the temperature of the air, the lower will the visible spout descend; so that, if they had been assumed only six degrees apart, in the above case, the apex of the spout would have descended to the earth. And, if they had been assumed still nearer together, the spout would not only have descended to the earth, but it would have been of some considerable size there. Thus we find that this mode of calculation not only enables us to account for the more frequent appearance of these spouts in the day than in the night, but also to assign a reasonable, hypothetical cause, why these spouts, or storms, are sometimes broad, and sometimes narrow, and sometimes even do not reach down to the surface of the earth.

It is known, also, that spouts, and violent storms, are always preceded by calms. This fact, also, is easily explained by the theory. For, in the first place, it is known that a calm favours the production of a high dew-point, which is an essential ingredient in these storms; and, second, a vortex of great strength cannot be formed, unless it can rise nearly perpendicular to a great elevation, which never can happen where there is a strong wind. This will readily be admitted, when it is considered that the wind is always stronger at some distance above the surface of the earth, than at the surface itself; and, therefore, no vortex of any great height, in these circumstances, could be formed, for the upper part would be blown away from the lower.

I have frequently seen those large columnar clouds, which form in mid air during a warm summer's day, have their tops blown off by an upper current, when the lower air was almost still, and thus a vortex of great strength prevented from forming. That these clouds are actually formed by rising vortices, occasioned by the disturbance of the equilibrium of the air during the day, is rendered almost certain by the following facts. First. When the supply is cut off in the evening, by the air near the surface of the earth becoming cold, these clouds cease to form, and not unfrequently disappear, and a day with many clouds is followed by a cloudless night. On the supposition of upward vortices, this phenomenon is very simple and natural; but on any other supposition, it is utterly paradoxical, (especially when it is now known that depression of temperature is the only cause of the condensation of aqueous vapour,) how clouds can be formed under a

meridian sun, which will be dissipated under the refrigerating influences of a nocturnal sky.

Second. I once saw, during a profound calm, those columnar clouds, in all parts of the heavens, appear to be coming slowly towards me, which I think can only be accounted for by supposing that they were all rising perpendicularly. These clouds, however, were gradually dissipated after they had increased to a considerable size, which proves beyond doubt that they were surrounded by air, at that elevation, whose dew-point was below the temperature of the air; and it may be added, that this is one of the cases where a spout cannot be formed, for the ascending air of the vortex will always, more or less, be mingled with the air through which it passes.

Again, nothing but an upward or a downward vortex will account for the well known fact, that, in these storms, the clouds are frequently seen to rush together with great rapidity, for some time, without overlapping each other, and crossing, which proves that they are on the same horizontal plane, and so demonstrates the existence of a vortex. I need hardly add, that other phenomena show that the motion, after meeting, is upwards, and not downwards.

Clouds have also frequently been seen to ascend, by spectators on mountains, and aeronauts have found their temperature much higher than the surrounding air. Thus, it is demonstrated, beyond all doubt, that there is an upward current in these storms, whether the latent caloric given out by the condensation of the vapour, is the cause of that current, or not. And, as no fact in physics is better established than that precipitation will instantly take place, if saturated air is suddenly rarefied, we are sure, also, that this upward motion of saturated air will, by causing expansion, produce precipitation.

I had long been desirous to ascertain, by actual observation, how high these vortices carry the condensed vapour, or cloud, into the upper air, and a fine opportunity was afforded me, on the 31st of July, 1834. This morning, says my journal of that day, it began to rain early, with the wind and lower clouds north-east, middle clouds south, and upper clouds west. Several showers occurred during the morning, and the wind gradually shifted round to the south-east. At 5 o'clock, P.M., a most violent shower, which lasted about fifteen minutes, came up from the north-west, and at the moment of the hardest rain, the lower wind being strong from the north-west, the lowest visible clouds in a south-east direction, were seen to move with great velocity in the opposite direction, towards the north-west.

As soon, however, as the shower passed off to the south-east, the lower clouds changed their course, and followed the shower towards the south-east, exposing to view, near the zenith, a most magnificent columnar cloud, with its summit and western side as white as snow, being exposed to a western sun, in a perfectly clear sky. This cloud seemed nearly stationary for some time in its upper snowy part, while the scattering clouds in its lower parts were seen to rush under it, towards the south-east, with great velocity. The principal cloud moved slowly and majestically towards the ESE.; the sun's rays gradually climbing up this mountain of snow, fourteen minutes after he set, his last beams ceased to illuminate its summit.

The altitude of this summit being taken by a sextant, was found to be nine and a half degrees. The line which bounded light and darkness, as it rose up the sides of this columnar cloud, was well defined, the western horizon being entirely free from clouds, so that I think I could not be mistaken one-quarter of a minute in the time when the sun's rays ceased to

shine on the top of the cloud. Calculating from these data, I find the cloud reached to the amazing height of eleven miles, and that it travelled east-south-east, with a velocity of about forty-eight miles an hour.

A much more violent storm than this had occurred at Wilmington, (Del.) about twenty-eight miles south-west of Philadelphia, two days before this, as appears from Dr. Gibbon's Journal. He says it commenced raining with a thunder gust, at 5 o'clock in the morning, and poured down in torrents till half-past 7, when it ceased. In this short time, two and a half hours,  $5\frac{1}{10}$  inches of water fell. This rain, he says, did not extend further than ten or fifteen miles from Wilmington, in any direction, except, perhaps, in an easterly course, in New Jersey.

On that evening, my journal says, "The upper clouds from the WSW. were tinged with pink, thirty-one minutes after seven o'clock, mean time. These clouds, being in the zenith, must have been the astonishing height of fourteen miles.

The angular velocity of one of these upper clouds was taken; it was found to rise from  $25^{\circ}$  to  $32^{\circ}$ , in two and a half minutes. Its absolute velocity, therefore, at this great height, was about two miles a minute. This great velocity is not at all inconsistent with the velocity with which storms are known generally to travel towards the north-east, in our latitude, even on supposition that this direction is given to the upward vortices of these storms, by this uppermost current, as explained before; for the inertia of the air in the vortices must be overcome, and, therefore, the velocity of the storm, at least the hinder part of it, cannot be so great as the velocity of this uppermost current.

There are many well authenticated accounts of showers of dust, and bloody, or, as I imagine, reddish rain, having fallen, and also of hail, with earthy or stony matter contained in the stones, and some with green leaves of forest trees; all these facts are mere corollaries from the theory. Prof. Zimmermann analyzed the sediment of some red rain which fell on the 3d of May, 1821, near Geissen, and found it to contain chrome, oxide of iron, silex, lime, carbon, and a trace of magnesia, but no nickel. On the 13th of August, 1824, in the city of Mendoza, in Buenos Ayres, dust fell from a black cloud, and at the same time, in another place, distant forty leagues, the same phenomenon occurred.

In Persia, near Mount Ararat, there fell, in the month of April, 1827, a shower of *seeds*, which, in some places, covered the earth to the depth of six inches. The sheep ate of it, and men made a tolerable bread of it. The French ambassador in Russia obtained some specimens of this grain, and sent them to Paris, where they were analyzed and examined by MM. Desfontaines and Thenard, and determined to be lichens of the genus *Lecidea*.

Now, as neither leaves of forest trees, nor seeds of lichens, can grow in the upper regions of the atmosphere, or be precipitated to the earth from any other planet, if these accounts are believed, and M. Pouillet doubts not the truth of them, then the existence of upward vortices, however these vortices may be formed, is established.—[Pouillet, p. 770.

The theory will also account for the water spout. Indeed, a spout at sea, and a spout on land, are identically the same thing, and many have been known to pass from water to land, exhibiting the same appearance in both situations. To show their identity, I will copy from Silliman's Journal, vol. xiv., p. 171, an account of a water spout seen off the coast of Florida, in the spring of 1826, by Benjamin Lincoln, M. D., of Boston.

"April 5th.—At 6 o'clock, A. M., an order was heard from the deck to

get ready the gun on the weather quarter, and bring the muskets from the cabin. Recollecting what region we were in, my first thought was of an engagement with a piratical cruiser, but on going upon deck, it appeared that our enemy was a water-spout, bearing north, distant, according to the captain's estimation, about two miles, and coming down upon us before a whole-sail breeze. One musket was fired at it, but it had nearly effected a retreat before we got ready for action. I had just time to see it, and it disappeared.

"In a few minutes another appeared, which was said by the officers of the vessel to be much more distinct than any one they had ever seen before. I observed it attentively, but neglected to note the time, except at its commencement, and the end of the third spout, which appeared after the second and principal one had passed away. This omission renders it impossible to give the duration of its different stages with any good degree of exactness. The wind came from the land, blowing a whole-sail breeze. The thermometer stood at  $72^{\circ}$ . A black cloud, from which the spout proceeded, extended along from east to west, its lower edge very distinctly defined, even, parallel to the surface of the water, and elevated  $25^{\circ}$  or  $30^{\circ}$  above the horizon. No other cloud was visible in that quarter, but a haziness covered the whole heavens.

"A small, black, and perfectly defined cone, darted from the lower edge of the cloud, and pointed perpendicularly to the water, which, at the same moment, was seen flying upwards like spray on the rocks. It was distinctly noticed that the cloud grew blacker near the cone, appearing to be gathered in from all quarters, and condensed at this point.

"After the lapse of two or three minutes, the cone instantaneously extended itself to about twice its first length, and the water was thrown up higher. This continued a few minutes; then the apex of the cone suddenly leaving the truncated end jagged, from which little scirrhi were continually darting and disappearing, the water continuing as before. This appearance lasted two or three minutes, after which the cone gradually elongated itself, assumed the cylindrical shape, except near its junction with the rest of the cloud, and descended almost to the surface of the water. The time occupied by the descent was about two seconds. All these changes were instantaneous, except the descent, which was gradual. As the spout descended, the agitation of the water increased, boiling up on each side of the end of the spout, but not coming in contact with it. The spout was slightly curved, the convexity of the curve being towards the point whence the wind came. It appeared to be hollow, light in the middle, and black, like the cloud, at its sides. A waving, ascending motion, was distinctly seen in the middle, more distinctly near the water than near the cloud. This the sailors, with one accord, pronounced to be water going up the spout.

"This appearance lasted fifteen minutes, or more, the spout remaining entire and unchanged. Then it began to fade, and suddenly a section from its lower end disappeared, leaving the same scirrous jagged extremity before mentioned. One section after another disappeared in this way, the spout continuing to grow paler, the waving motion growing more distinct and slow, and the agitation of the water subsiding, till the whole disappeared. By this time, the wind had freshened considerably, and the cloud had spread over a great part of the heavens. In a few minutes after, another cone appeared, exactly like the first in all respects, and the same appear-

ance was exhibited in the water under it. This continued a short time, and then disappeared.

"From the appearance of the first cone, till the disappearance of the last, was three-quarters of an hour.

"The wind continued to increase, and the cloud to gather blackness, and spread in every direction, till it enveloped the whole heavens. Next came a most vivid flash of lightning, with a most tremendous peal of thunder. It seemed as if heaven and earth had exploded at once, and in an instant all was calm, the sails hung loose, and not a breath of wind could be felt. Rain now began to fall, not in drops, but in torrents, and the wind came in gusts from every point of the compass. It continued to rain and blow in this way about fifteen minutes, after which it ceased, the wind in its former direction, the sky became clear, and we went on our way."

If any one will carefully examine the phenomena here described, and compare them with the two land-spouts described above, he will perceive their exact similarity in all the most important features,—the gathering in of the clouds at the upper end of the spout, where it lost itself in the cloud; the inverted cone of thick vapour descending; the commotion of the water, and the removal of the earth under the spout; and, above all, the rain that occurred after the termination of the spout.

It is worthy, also, of particular remark, that the rain lasted exactly the same length of time that the principal spout lasted, fifteen minutes, and probably it commenced thirty minutes after the spout, or fifteen minutes after its disappearance. And as this rain, and the spout, were undoubtedly parts of the same phenomenon, and if, according to the theory, the rain was condensed in the spout, and carried up by the spout, we are led to believe it must have been carried up a great distance, or it would not have taken thirty minutes to ascend and descend. It is true, that, in ascending, it would move upwards much slower than the vortex of air which carried it, for the drops would gradually increase in size in their upward motion, by the finer particles of condensed vapour constantly overtaking them in their course, and uniting with them, until, by their increasing size, and the diminishing force of the air, from its diminishing density, they would stop their upward motion, and be thrown off at the sides of the vortex, as explained before.

It is worthy of remark, also, that the suddenness with which "the cloud gathered blackness, and spread in every direction, till it enveloped the whole heavens," is easily and naturally accounted for by the outward motion of the vortex above, as explained in a preceding part of this essay. Even the direction in which the spout leaned, from the wind, could have been predicted from the theory.

In the *Edinburgh Philosophical Journal*, vols. v. and vi., are given descriptions and plates of water-spouts, which appear to me almost to demonstrate, of themselves, the theory here advanced. Several of these spouts were attended with rain, at the distance of about a quarter of a mile from the spout, and they all began to descend from the cloud in the form of an inverted cone, and gradually proceeded downwards to meet a smoke-like appearance, which rose from the surface of the water to meet it.

This cone was black at first, but, towards the end, it began to appear like a hollow canal; the sea water could, even while it was entirely black, be seen very distinctly flying up along the middle of it, as smoke does up a chimney, with great swiftness; and the wind, in all instances where men-

tioned, blew towards the spout below. These phenomena, with the exception of the hollow canal, have already been explained.

In the fourth volume of the Abridgment of the Transactions of the Royal Society of London, a description of many other spouts is given, attended with circumstances similar to those already described. One of these occurred in England, on the 3d of June, 1718. "It was stationary for a length of time not mentioned, and discharged an immense quantity of water, without thunder. It fell on a space about sixty feet over, and tore up the ground there seven feet deep to the rock, and made a deep gulf for about half a mile from that place, raising a stream below, so as to render it impassable." All this must have occurred in a few minutes, as, immediately on the appearance of the spout, some persons attempted to run home, but they found the brook already impassable.

By having deferred the publication of these essays so long, I am now enabled to refer to a highly interesting account of some water-spouts, seen by Lieut. H. W. Ogden, and communicated in the January number of *Siliman's Journal*.\*

It was in May, 1820, in the edge of the gulf stream, the weather being very warm, and the atmosphere close and oppressive, when seven were seen in half an hour, varying in their distance from the ship, from two hundred yards to two miles. Lieut. Ogden says, "The atmosphere was filled with low, ashy coloured clouds, some of which were darker underneath than others, and from these the water-spouts were generally formed, each one from a separate cloud. In some instances, they were perfectly formed before we observed them, but, in others, we could see a small portion of the cloud, at first extend downwards, in the shape of an inverted cone, and then continue to descend, not very rapidly, until it reached the water. In other instances, however, we observed that this conical appearance of a portion of the cloud did not always result in the perfect formation of a water-spout. Several times we saw the cone project, continue for a short time stationary, then rise again slowly, and disappear in the clouds. This would, in some cases, occur two or three times to the same cloud; but, eventually, a larger and darker cloud would descend, and result in forming the visible spout, as above mentioned."

One spout passed within sixty yards of the ship, and, after having been visible more than twenty minutes, at the distance of about three hundred yards, its lower part became smaller, and then gradually rose, until entirely lost in the cloud, part of which still hung over them. Soon after this, several severe flashes of lightning struck near the ship, and the rain began to fall in large and very *cold* drops, perfectly *fresh*.

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### Bibliographical Notice.

*The Naval Magazine*, edited by the Rev. C. S. Stewart, M. A., aided by an Advisory Committee.

We hail with pleasure the appearance of the first number of a periodical bearing the above title. There can be no doubt but that a journal devoted to the objects and interests of naval science, and naval men, will produce the happiest results. We trust that a feeling of esprit de corps will connect itself with this publication, and that officers will be induced to exertion for

\* See also *Naval Mag.* No. 1, vol. I.

the purpose of contributing to their *own* magazine, which they might not be disposed to make for one not purely professional. To this journal we must look for information as to those means best calculated to improve this important branch of our national defence. A naval school, ably and warmly urged, would, we feel satisfied, be brought nearer to its establishment, than by awaiting the slow progress of public opinion, now beginning to move decidedly in its favour. Independent criticism of existing defects; judicious observations on the merits or defects of the services of other nations; suggestions of improvements in naval science or practice; details of nautical operations, and of those matters of practical science which are connected with the profession, will afford, of themselves, a most abundant field of usefulness. Literature will strew some of her flowers over these more rugged paths, and sketches of scenes on shipboard, or on land abroad, lend interest even to the general reader.

An earnest is given of co-operation with us in meteorology, a branch which naval men have so strong a necessity to study, and such excellent opportunities of studying to good purpose, by the publication of the meteorological circular of the Joint Committee of the American Philosophical Society and Franklin Institute, and of a meteorological table for January, 1836, by Dr. William Swift, of the New York naval station.

We look with interest for the appearance of the new work, announced in the pages of the journal, on navigation, by passed midshipman Maury, of the United States' navy. B.

## Franklin Institute.

### *Monthly Conversation Meeting.*

The sixth monthly conversation meeting of the Institute, for the season, was held at their Hall, February 25th, 1836.

Mr. Franklin Peale exhibited a working model of a press, for cutting out coin, intended to be worked at the United States' Mint, by steam power. Specimens of a medal struck in commemoration of the first steam coinage, were presented.

Messrs. B. Slater & Co. submitted for examination, a patent stop motion for roving frames, invented by T. and J. O. Lewis, of Wilkinsonville, Mass. The stop was simple and effective.

A model of a canal boat, by Mr. A. Mason, of Pittsburgh, was upon the table.

Col. B. Chew, Jr. made some general remarks in regard to the working of the salt springs of Pennsylvania, inviting inquiry into the source of the brine, with a view to what he considered might be a more effective mode of obtaining salt.

Mr. John C. Cresson presented a specimen of Alabama cotton, in the pod.

Prof. A. D. Bache showed the action of a safety alarm for steam boilers, described by him in the Journal of the Institute in 1832, and recently made the subject of experiment by the Committee on the Explosions of Steam Boilers.

## REPORT OF THE COMMITTEE OF PREMIUMS AND EXHIBITIONS.

*Ninth Exhibition of Domestic Manufactures, held by the Franklin Institute, of the State of Pennsylvania, for the Promotion of the Mechanic Arts.*

To the Managers of the Franklin Institute.

The Committee on Premiums and Exhibitions report—

That the Ninth Exhibition of the Institute was held agreeably to the announcement of the Board, on the 7th, 8th, 9th and 10th of October.

In presenting the result of their labours, the committee have great pleasure in congratulating the Institution and the community upon the rapid advancement to perfection in many branches of industry, of which they have received evidence from the display now closed. To those whose intimacy with the progress of these exhibitions of the Institute, enables them to recur to the state of the arts in this country, as evinced at its early exhibitions, the decided superiority of the fabrics of the present day, is peculiarly striking, and it must be a source of no small gratification to them to reflect how much the country is indebted to the exertions of the Institute, in producing this improvement, by exciting emulation among the producers, and by introducing their fabrics to the notice of the consumers.

In furtherance of the objects which this Institute have had in view, results of a similar character have been had in our sister city, New York, by the exertion of similar institutions, and the committee take this opportunity to express their satisfaction at the good feeling which exists between them and this society. Delegations from the American Institute, whose fair was held during the week subsequent to ours, and from the Mechanics' Institute, whose fair had been previously held, visited the Exhibition of this Institute. The good feeling thus expressed was reciprocated on our part by sending a delegation to the fair of the American Institute, and it is to be regretted that circumstances prevented our sending one to that of the Mechanics' Institute also.

If at the exhibition of this institution just closed, the number of specimens presented was not so great as on some former occasions, it must be attributed to a cause at which all will rejoice. The uncommon prosperity of the manufacturing community has prevented many who usually contribute their share to enhance the splendour of our shows from presenting samples of their work, in very many branches of industry, the manufacturers have found themselves during the past summer unable to keep pace with the growing demand.

Of the Premiums offered by the Institute in the printed list, a large number have been claimed by competitors which the committee, after a fair investigation of their respective merits, by disinterested judges, appointed for that purpose, have awarded as follows.

*Cotton Goods.*

Premium No. 75. For the best samples of checked and corded muslin, is awarded to Joseph Bancroft, of Wilmington, Del. for specimen No. 222, decidedly the best of the kind that had come under the notice of the judges.

Premium No. 82. For the best samples of rich chintz prints, for ladies' dresses, is awarded to Philip Allen, of Providence, R. I. for specimen No. 174, of which the judges remark that the style is excellent, the colours brilliant, and the printing accurate.

Premium No. 85. For the best samples of cotton handkerchiefs, in imitation of Madras, to measure square, of cotton yarn not under No. 40, is awarded to William H. Cheetham, of Philadelphia county, for specimen No. 38, superior, in the opinion of the judges, to any before exhibited.

Premium No. 86. For the best samples of 4-4 fancy striped or checked gingham, in imitation of Scotch; of yarn No. 40 or upwards, is awarded to William H. Cheetham, of Philadelphia county, for specimens No. 35, 36 and 37, being superior, in fineness of texture, colouring, and general finish, to any that have before come under the notice of the judges.

Premium No. 90. For the best samples of pantaloons stuff, 3-4 to 7-8 wide, all cotton, or cotton and wool, is awarded to William H. Cheetham, of Philadelphia county, for specimens No. 33 and 34, which closely resemble the foreign article, and were much sought after during the past summer.

#### *Woollen Goods.*

A certificate of honourable mention is awarded to W. & D. D. Farnum, of Waterford, Mass. for specimen No. 140, a small piece of sattinet, of which the judges remark that it is not surpassed by any similar article which has ever come under their inspection. Had the quantity of this article been sufficient, it would have been entitled to the premium.

A certificate of honourable mention is awarded to the Pequonnock Company, Bridgeport, Mass. for specimens No. 156, three printed table covers, which the judges pronounced to be highly creditable specimens of a new branch of manufactures.

#### *Carpets.*

Premium No. 106. For the best sample of Venetian carpeting 27 or 36 inches wide, is awarded to Isaac Macauley, of Philadelphia, for specimen No. 342, extremely well manufactured, chain very fine, colours good.

Premium No. 107. For the best specimen of Brussels carpeting, 27 or 36 inches wide, is awarded to Isaac Macauley, of Philadelphia, for No. 487, one piece of well manufactured goods, showing considerable improvement since the last exhibition.

A certificate of honourable mention is awarded to Miss Sarah Ann Fling, of Philadelphia, for specimen No. 593, a hearth rug, exceedingly well manufactured, and handsome design.

#### *Silks and Laces.*

A certificate of honourable mention is awarded to Joseph Ripka, of Philadelphia, for specimen No. 346, a small parcel of sewing silk of excellent quality, but not in sufficient quantity to be entitled to the premium.

A certificate of honourable mention is awarded to Boswell and Crowley, of Philadelphia, for specimen No. 312, a lot of pongee handkerchiefs dyed by them upon which much commendation was bestowed for the beauty and regularity of the colour.

#### *Straw Bonnets.*

The Silver Medal of the Institute is awarded to Miss E. White, of Philadelphia, for specimens No. 122, several straw bonnets, which were much admired for neatness of style and excellence of quality.

*Surgical Instruments.*

The display of Surgical Instruments was very extensive, and afforded gratifying evidence of the high state of perfection attained in this branch of the arts. Two sets of amputating instruments, No. 256, made by Wiegand and Snowden, and No. 298, made by George P. Schively and Co. both of Philadelphia, were selected by the judges as most worthy of premium No. 52; but upon a minute comparison, their merits appeared so nearly balanced that it was impossible to determine which was best. Under these circumstances the committee have awarded to George P. Schively and Co. a certificate of honourable mention; Mr. Wiegand being a member of the Board, cannot, under the regulations of the exhibitions, receive any award.

A certificate of honourable mention is awarded to John Rorer and Son, for specimen No. 488, a lithontriptic instrument, admired for its high finish.

*Cutlery.*

Premium No. 60. For the best saddlers' tools, is awarded to J. English and H. & F. A. Huber, of Philadelphia, for specimen No. 12, an assortment of saddlers' tools, which were pronounced by the judges superior to those usually imported.

A certificate of honourable mention is awarded to N. P. Ames, of Springfield, Mass. for specimens No. 407, five swords of excellent quality and finish.

A certificate of honourable mention is awarded to F. W. Widmann, of Philadelphia, for his specimens of sword mountings, which are highly creditable to the maker for the chasteness of the design and beautiful finish of the work.

A certificate of honourable mention is awarded to Rochus Heinisch, of New York, for specimens No. 249, several pair of compound lever shears, the form of which was correct, and the polish very perfect.

*Hardware.*

Premium No. 41. For the best brass wire of assorted sizes, from No. 70 to 25, is awarded to Holmes, Hotchkiss, Brown and Elton, of Waterbury, Conn. for specimen No. 281.

Premium No. 55. To the maker of the best stock or standing vice, equal to those known by the name of tower vices; is awarded to A. Lamont, of Pittsburg, Pa. for specimens No. 166, five bright vices, which will not suffer by comparison with the celebrated vice adopted as a standard.

Premium No. 57. For the best wood screws of iron or brass, assorted sizes, from one-fourth of an inch to 3 inches, is awarded to J. G. Pearson and Brother, New York, for specimens No. 267, an assortment of wood screws, fully equal in cutting and finish to those usually imported from England.

Premium No. 58. For the best screw augurs, assorted sizes, from two to eight quarters; is awarded to David Basset, of Derby, Conn. for specimens No. 378, which the judges believed would give entire satisfaction to the mechanic, and exclude foreign competition.

Premium No. 70. For the best portable scales, to weigh from 3 lb. to 12 cwt. is awarded to E. and T. Fairbanks and Co. of St. Johnsbury, Vt. for specimen No. 157, a portable platform compound lever scale, which long experience has proved to be extremely accurate.

A certificate of honourable mention is awarded to Joseph Nock, of Philadelphia, for his fire-proof chest lock, ingeniously devised to sound an alarm.

A certificate of honourable mention is awarded to Scovill and Co. of Waterbury, Conn. for their specimens of brass hinges, which are rapidly driving the foreign article out of the market.

A certificate of honourable mention is awarded to Webster and Co. of Albany, New York, for their specimens of enamelled hollow ware, which they have succeeded in bringing to great perfection.

A certificate of honourable mention is awarded to D. Simmons and Co. of Albany, New York, for the specimens of edge tools, of their manufacture, which were judged equal in quality and general finish to any made in this country, and much superior to the imported article.

A certificate of honourable mention is awarded to Rockwell and Hinsdale, of Winchester, Conn. for their scythes and straw knives, which were highly commended by the judges.

A certificate of honourable mention is awarded to Thomas and Benjamin Rowland, of Cheltenham, Philadelphia county, for specimens of shovels and spades, and of long saws, which justly bear a very high reputation.

A certificate of honourable mention is awarded to Israel White, of Philadelphia, for an assortment of carpenters' planes, finished in a very workmanlike manner.

A certificate of honourable mention is awarded to Edward W. Bushnell, of Philadelphia, for his specimens of gauges and squares; tools much in demand, and possessing all the requisite qualities to insure good work.

#### *Silver Ware.*

A certificate of honourable mention is awarded to R. and W. Wilson, of Philadelphia, for the chasteness and beauty of their specimens of silver ware, which were much admired.

There was also an extensive assortment of this beautiful ware, from the manufactory of Fletcher and Bennett, which contributed much to enhance the splendour of the exhibition, but as Mr. Fletcher is an officer of the Institute, he is precluded from competition.

#### *Saddlery.*

A certificate of honourable mention is awarded to James E. Brown, of Philadelphia, for specimen No. 67, a set of coach harness, very neat and creditable to the maker.

A certificate of honourable mention is awarded to A. M. Wagner, of Philadelphia, for specimen No. 120, a gentleman's saddle, esteemed by the judges a very superior article.

A certificate of honourable mention is awarded to T. Benninghove, of Philadelphia, for specimen No. 381, a fancy bridle and martingale, a very difficult and well executed piece of work.

#### *Stoves and Grates.*

A certificate of honourable mention is awarded to Joseph Snyder, of Philadelphia, for specimen No. 414, a parlour grate of very neat pattern, and designed to economize the heat by means of a circulating air chamber.

A certificate of honourable mention is awarded to R. Pierpont, of Taunton, Mass. for specimen No. 72, a doric fire-place, favourably spoken of by those who have given them a trial.

*Philosophical Apparatus.*

The silver medal of the Institute is awarded to William J. Mullin, of New York, for his specimens of watch dials, a very beautiful article.

A certificate of honourable mention is awarded to Alva Mason, of Philadelphia, for his specimens of philosophical apparatus.

A certificate of honourable mention is awarded to Isaac Schnaitman, for his improved double lens spectacles, highly approved by the judges.

A certificate of honourable mention is awarded to Thomas Ewbank, of New York, for his syphons, which will be found very useful in transferring liquids. The judges suggest that these should be referred to the Committee on Science and the Arts.

*Guns.*

Premium No. 7, to the maker of the best rifle gun, with percussion lock, and double or hair trigger, to carry balls from 60 to 100 to the pound, is awarded to Allen & Ball, of Springfield, Mass. for specimen No. 212, an examination of which, by competent judges, could not fail to procure for it high commendation. Several other specimens were presented by Messrs. Allen and Ball, which bore testimony that they came from a master hand.

*Models and Machinery.*

A certificate of honourable mention is awarded to S. Gerhard, of Camden, N. J. for No. 566, a machine to facilitate the manufacture of shoes, which evinced much ingenuity.

*Lamps.*

Premium No. 30, to the maker of the best and most extensive variety of mantel, astral, or hanging lamps, is awarded to Christian Cornelius and Son, for the rich and beautiful exhibition of these articles, from their workshops, equal in beauty and excellence to any of foreign manufacture.

This country is much indebted to Messrs. Cornelius, for the advanced state which this useful art has attained.

*Musical Instruments.*

After an elaborate and careful comparison, the judges report, that they would be guilty of great injustice to more than one maker, were they to recommend the award of a premium to any specimen exhibited; so near did they approach each other in excellence, a great improvement being manifested in all the instruments since last exhibition. Certificates of honourable mention are therefore awarded to Messrs. Conrad Meyers, C. F. L. Albrecht, E. N. Scherr, Groves and Wohlen, William Feuring, Loud and Co. and Thomas Loud.

In one of the pianos exhibited by Loud & Co., a new arrangement has been introduced, under the name of compensating tubes, intended to sustain the instrument in tone through different changes of temperature. This is considered, by the judges, one of the greatest improvements that has been effected in this instrument for a long time. But, as it is an invention coming more directly within the province of the Committee on Science and the Arts, it is referred to them for the purpose of receiving, if original, the Scott's legacy premium.

*Paints and Colours.*

The silver medal of the Institute is awarded to George C. Osborne, of

Philadelphia, for specimen No. 13, a case of water and oil colours in cakes. By the latter production, Mr. Osborne has supplied a want long felt by artists. It is deemed by the judges a very important invention, being much more convenient for landscape and miniature painting, than any other mode of preparation.

Several gallons of copal varnish were offered in competition for premium No. 117; this will be subjected to the test of twelve months' use, according to the terms of the premium, and the results made known in a future report.

#### *China and Glass.*

Premium No. 23, to the manufacturer of the best specimens of porcelain, is awarded to Judge Hemphill, of Philadelphia, for the assortment of this beautiful ware from his manufactory, most of which exhibited a decided improvement since the last exhibition, and will compare advantageously with the French china.

Certificates of honourable mention are awarded to the New England Glass Company, and to the Boston and Sandwich Glass Company, for their specimens of glass ware, considered by the judges highly creditable to the manufacturers.

A certificate of honourable mention is awarded to George Drummer, of Jersey city, for specimens of astral lamp shades, some of which were of extraordinary size.

A novel and interesting exhibition was furnished from the pottery of Mr. Abraham Miller, of Philadelphia, consisting of a variety of specimens of black and red earthenware, in the various stages of its manufacture, from the crude material to the finished ware.

#### *Marble Work.*

Premium No. 128, for the best urn in marble, for a monument, is awarded to James Stewart, a lad in the employ of Mr. John Struthers, for specimen No. 248.

A considerable variety of marble mantels was presented at this exhibition, an examination of which affords conclusive evidence that home-bred artists can produce specimens of ornamental carving, equal in richness and elegance to any that can be obtained in foreign countries. The merits of the different mantels exhibited was so nearly balanced, that a premium could not justly be awarded to any one. The committee have, therefore, awarded certificates of honourable mention to Messrs. Tennant & Highlands, for specimen, No. 214, and to Vanderbilt, Bacon & Wilde, for specimen, No. 347.

Two carved mantels, No. 437, and a carved tablet, No. 476, intended for a mural monument, were exhibited by John Struthers. These were both excellent specimens of work, but as Mr. Struthers is a member of the Board, he is precluded from receiving any award.

A certificate of honourable mention is awarded to David G. Wilson, a lad in the employ of Mr. Henry Sailor, for specimen No. 96, a piece of carving, which affords promise of future eminence in his occupation.

A certificate of honourable mention is awarded to John Batten, for specimen No. 250, a bust of William Strickland; and No. 261, a head of Ariadne, in relief; the execution of which confers much credit upon the sculptor.

*Cabinet Ware.*

A certificate of honourable mention is awarded to James Kite, of Philadelphia, for specimen No. 145, a writing desk, made of a variety of American woods, introduced with skill and good taste.

There were several other specimens of cabinet ware exhibited, which, both in style and workmanship, were creditable to the makers, and fully sustained the character which Philadelphia has borne of preeminence in this branch of manufactures.

*Leather, and Manufactures of Leather.*

Premium No. 113, for the best specimens of white sheep skins, suitable for apothecaries' use, finished equal to that now imported from France, is awarded to Doyle & M'Neely, of Philadelphia, for specimen No. 306, two dozen skins, well got up.

A certificate of honourable mention is awarded to Doyle & M'Neely, of Philadelphia, for specimen No. 305, two bundles of morocco boot leather, of very superior quality.

A certificate of honourable mention is awarded to J. P. Alberger, of Philadelphia, for specimen No. 144, a russet trunk, well finished, and substantial.

*Hats.*

A certificate of honourable mention is awarded to C. F. Raymond, of Philadelphia, for his specimen of four dollar hats, the quality of which was very superior, and would have entitled him to the premium, had he exhibited the requisite quantity.

Certificates of honourable mention are awarded to Thomas Elmes & Co. and to Wilson & Laing, for their specimens of silk hats, pronounced, by the judges, the best exhibited.

A certificate of honourable mention is awarded to Brown & Siddons, for the improvement manifested in the hair seal caps manufactured by them.

A certificate of honourable mention is awarded to J. Chandler Smith, for the superior six dollar and nine dollar hats exhibited by him.

A certificate of honourable mention is awarded to E. Kimber, Jr., for his specimens of fur bonnets.

*Books and Stationary.*

Premium No. 13, to the maker of the best white vellum quarto post paper, made from the best No. 1 domestic rags, weighing not less than eight pounds per ream, is awarded to the Brandywine Manufacturing Company, for specimen No. 189.

The other articles of stationary were numerous, and some of them very creditable to the trade, but there was nothing among them requiring a special award.

*Fancy Articles.*

The silver medal of the Institute is awarded to John Yard, Jr., of Philadelphia, for his beautiful display of pearl work, in the manufacture of which he has attained great perfection.

The silver medal of the Institute is awarded to the Pennsylvania Institution for the Instruction of the Blind, for the general assortment of their manufactures, an inspection of which affords pleasing evidence that the individuals who compose this unfortunate class are capable of becoming useful members of society.

A certificate of honorary mention is awarded to Reuben S. Gilbert, of

Philadelphia, for specimens of engraving on wood, evincing very great improvement in this art.

A certificate of honourable mention is awarded to the pupils of the north-western public school, for specimens of lace work, of superior quality.

*Paper Hangings.*

A certificate of honourable mention is awarded to Charles Longstreth, of Philadelphia, for his varied and beautiful display of paper hangings, which do much credit to his skill and good taste.

The brevity required in this report necessarily excludes a great variety of interesting articles, which deserve commendation; but as the committee intend availing themselves, as far as practicable, of the reports of the judges, for future publication, the merits of these will be more fully and satisfactorily discussed.

The committee cannot close their labours without expressing their obligations to the gentlemen who composed the committees of arrangement, and of judges, for their exertions in forwarding the views of the Institute, and promoting the great cause in which it is engaged.

All which is respectfully submitted.

SAMUEL V. MERRICK,  
JOSHUA G. HARKER,  
WILLIAM H. KEATING,  
FREDERICK FRALEY,  
ISAAC B. GARRIGUES,  
ALEXANDER MCCLURG,  
ALEXANDER FERGUSON,  
JOHN C. CRESSON,

Committee on Premiums and Exhibitions.

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## Mechanics' Register.

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### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN OCTOBER, 1835.

*With Remarks and Exemplifications by the Editor.*

1. For an improvement in the *Double Speeder*; William Field, North Providence, Providence county, Rhode Island, October 6.

This improvement "consists in a plan of compressing the roving on the spool so hard, or compact, that the same quantity may be put on a spool of only one-fifth of the common size. A machine with this improvement will occupy only one-half of the room, will require much less power, and will run at least one-third faster than common speeders." The usual plans for drawing, twisting, and winding, the roving, are followed; but the spools are run faster than the flyers, to take up the roving, instead of permitting them to fall back, in the common manner. The flyers are supported wholly above and independent of the spindles, are about one-half the usual length and diameter, and have a hoop at their lower ends to prevent their expanding.

The condensation of the roving is effected by the pressure of a thin, circular, plate against it, as it is wound on the spool; the plate being about the same diameter as the spool.

The claims are to "the plan of compressing roving on spools by circular plates, having a rotary motion, acquired by their pressure on the spools, the edges of which act on the roving as it is received from the flyers, and thereby condense it, so that a much greater quantity can be deposited on spools of the same size. The sliding rail in the rear of the spools, on which the circular plates are placed, and the connection between the increasing size of the spools, and the traverse motion of the belt guide, so that the spools may cause the variation of speed which their constantly increasing size requires. The application of a heart motion for traversing the spools, so formed as to cause them to rise with greater velocity than they fall, so that a less quantity of roving may be deposited on the spools when rising than when falling."

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2. For an improvement in *Lamps*; Samuel Rust, city of New York, October 6.

The improvement here described is to be applied to lamps with flat wicks, and consists of a notched roller for raising the wick, the roller crossing it near its upper end, and being turned by the finger and thumb. We are much mistaken if such a contrivance has not been previously in use, for the same purpose.

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3. For *Glazing or Preparing Pelisse Wadding*; Stukely Turner, Cranston, Providence county, Rhode Island. First patented July 25th, 1833; patent surrendered, and reissued upon an amended specification, October 6.

At p. 37, vol. xiii., we gave a sufficiently full account of this apparatus, and remarked that it did not contain any claim; the surrender and reissue thereof is intended to cure this defect, the following claims being now made.

"Of the above described apparatus, I claim as my invention the improvement of taking the cotton from the carding machines, and carrying it on an apron, or aprons, to the first glazing roller. I also claim the placing at the other end of the machine, a second glazing roller, with two upper rollers, all constructed like the first, to glaze the other side of the sheet of cotton. I also claim the placing two pressing rollers, instead of one, over each glazing roller. I also claim the carrying the cotton to the second glazing roller by an apron, after it has passed over the first glazing roller, and of carrying the cotton after it has passed over both glazing rollers, and been glazed on both sides, on an apron, until it is sufficiently dried, and the rolling it on a beam, which is revolved by the friction of the last mentioned apron."

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4. For a *Planing Machine*; Reid R. Throckmorton, city of New York, October 6.

This machine differs from those which have preceded it to such an extent as, in our opinion, to merit the character of novelty; that of utility it must acquire, if at all, by its actual performance. The general arrangement of the apparatus only, is shown by the specification and drawing; but, if constructed from these, most of the details would have to be invented by the builder, as the information given is very defective in this respect. The plane is to be about three feet long, and its face is to be a segment of a circle, of about eight feet in diameter, and there are to be seven, or more, plane irons, or cutters, extending from it, of such width as may be necessary.

To the upper part of the plane, a rod, or shackle bar, is attached, the other end of which is moved by a crank, thus causing the plane to traverse, or rather to vibrate, backward and forward, with a rocking, or curved, motion. How the cutters are to be kept upon the plank, and caused to cut to a proper depth, does not appear, as, in the drawing, they are represented as standing out like knives, far below the face of the plane. Tongueing and grooving is to be effected in a similar way, by cutters operating laterally, and moved by a crank. The claim is to "the peculiar construction of the plane, and the nature of its motion, being vibratory and rectilinear," &c. There must be more in this machine than is described in the specification, or than meets the eye in the drawing, or it will be found of little value.

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5. For *Fire-places and Furnaces*; Ebenezer S. Greely, Dover, Penobscot county, Maine, October 6.

The patentee calls this an air fireplace, and says that the improvement is founded on its construction, and conveying heat from one room to another, without any risk of fire, &c. The whole affair consists in having the top, hearth, back, and jambs, of the fireplace, hollow, conducting air into them from without, and distributing it, when heated, by means of pipes. There is not any claim made to this mode of constructing fireplaces, and we presume that there are but very few of our readers who are not aware that, so far as our description goes, there is nothing to claim; the same may be said of the whole, as specified.

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6. For a machine for *Thrashing and Cleaning Clover, or Rice*; Moses Davenport, Phillips, Somerset county, Maine, October 6.

The machine here described consists of a long trough, containing the feeding, rubbing, and other apparatus. It is too complex for verbal description, but its characteristic feature appears to be, the passing of the seed between rubbing boards, covered with perforated metal, or otherwise made rough, the lower board being stationary, and the upper one, as it vibrates, bearing on the seed in one direction only, it being raised in the return stroke.

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7. For an improvement in the mode of *Rearing Silk Worms*; Gamaliel Gay, Poughkeepsie, Dutchess county, New York, October 6. (See specification.)

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8. For an improvement in the *Saw Mill*; Uri Emmons, city of New York, October 6.

The proposed improvement consists in hanging the saw, without employing a saw frame, and in using springs to counteract the weight of the saw, the pitman, and other appendages. The spring it is proposed to make of wood, and to fix it like that of a pole lathe. The saw is to have a jointed lever extended back from it, both at top and at bottom; these, when the saw is down, will be at right angles to it, and as they rise in a segment of a circle, will draw the saw back, so as to allow the feeding of the log. Both above and below the log, the saw is to pass between cheeks, or guide pieces, to keep it steady.

The claim is "to the construction and application of the first described spring to the common saw gate; and also the construction of the second

described apparatus in every respect, as they may differ from any thing else before used or known," &c.

The law requires that the patentee should distinguish his invention from all other things before used, or known; but, in the case before us, this task is put upon the public, a task from which they ought to be relieved, as it would impose upon them the ungrateful necessity of informing the patentee that saw gates have been sustained by reacting springs; that saws have been hung without frames, by vibrating levers; that guides, such as he has described, have often been used, and that they, therefore, are unable to discover any thing novel in his invention.

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9. For a *Chaffing Thrashing Machine*; Russel Bradley, Williston, Chittenden county, Vermont, October 6.

We cannot afford more lines to this apparatus than there are pages in the specification of it. The unthrashed straw is to be laid lengthwise in a feeding trough, where it comes into contact with a revolving cylinder, carrying circular saws, at short distances apart, serving to cut the whole into chaff; it then descends to a thrashing cylinder, and thence passes through a winnowing machine of the ordinary construction. The claim is to the application of the circular saws.

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10. For a *Spring Saddle*; Joel Woodward, Marshalton, Chester county, Pennsylvania, October 6.

The spring part of this saddle is confessedly similar to such as are already in use, consisting of a flat side, having a spring wound spirally round it; the claim to *improvement* is merely in the mode of putting the parts together by screws, so that they may be easily separated. The kind of spring used was made the subject of a patent about a year or two ago; the present patentee cannot, therefore, adopt it as his own, merely because he has put it together in what he deems a more convenient way. If the patent alluded to was for a plan previously known, and belonging to the public, he may certainly sustain what is new in his own mode.

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11. For a machine for *Shaving Staves, Heading, and Shingles*; John Everhart, Jacob Pearson, John Morford, and Nathan Everhart, Warren county, Ohio, October 6.

The specification of this instrument is laboured, but obscure; the drawing is very well executed, but does not exhibit the parts in detail sufficiently to make up for the defects in the description; the general construction of the apparatus, however, may be collected from the two; but we shall not dwell upon it, as it does not present any thing which, in our opinion, bespeaks it equal to several other machines for the same purpose, although it is the joint production of no fewer than four *inventors*. The articles to be shaved are laid upon a solid bench, and are forced to pass under fixed knives, by a lever, which is drawn against them by a badly constructed endless chain of iron, producing more than double the friction that is necessary. The claim is limited to this endless chain, and the cogged shaft by which it is to be drawn forward.

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12. For *Distilling Alcohol from Apples*; Anson Walcott, Bloomfield, Ontario county, New York, October 6.

The pommage is to be put into a steam-tight tub, into which steam is to

be admitted through a tube, which descends nearly to the bottom of it; a series of vessels, similarly connected by tubes, and perfectly resembling Woulfe's apparatus, is terminated by a condensing worm. The three last vessels, as represented, are to be hollow globes of metal, placed within open tubs, the water in which is to be sufficiently warm to keep the alcohol in the state of vapour, as, otherwise, it would condense in the hollow globes.

The claim is to "the application of steam in extracting alcohol from apple pommage, without first making it into cider, and the globular metallic condensers."

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13. For a *Plough*; William Walker, Washington, Columbia county, Pennsylvania, October 6.

The claim is to "the peculiar formation of the sheath, or standard, and the projections on the inner side of the mould-board, which give the sheath, or standard, a leaning position, and cause the plough to take land."

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14. For an improvement in the art of *Cutting, or Dividing, India Rubber*; William Atkinson, city of New York, October 6.

The improvement in the art, or process, of cutting India rubber, preparatory to dissolving it, consists in putting it into a machine, such as is used for the preparation of paper stuff, by the paper makers. The patentee says, "I do not claim to be the inventor of the machine employed by me, or any part thereof; but what I do claim is an improvement in the art of dividing, or cutting up, India rubber, preparatory to the dissolving thereof in any proper menstruum, either in the common paper machine, or in a machine made for the express purpose, and operating substantially upon the same principle."

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15. For a machine for *Laying Ropes*; John Goulding, Boston, Massachusetts, October 10.

A machine for laying ropes of three or more strands is necessarily complex; the specification before us contains fifty-one references to the drawings, which fully exhibit the construction of the whole of the apparatus. The claim is to the combination and arrangement of the several parts, as described. There are several machines patented, both here and in England, the operating parts of which strongly resemble those which are the subject of the present patent; the combination claimed may, probably, be sustained, but we believe that the patentee must, in this case, limit himself to the precise modes described by him.

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16. For an improvement in the machine for *Hatchelling Hemp, Flax, Tow, or Manilla Grass*; John Goulding, Boston, Massachusetts, October 10.

A patent issued to Mr. Goulding, on the 17th of August, 1835, for a machine for the above purpose, which he has since improved by the addition of a cylinder, which is said to render it more effective; to this addition, his specification and claim, under the present patent, are confined.

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17. For a *Horse Power*; Moses Davenport, Phillips, Somerset county, Maine, October 10.

The claim under this patent is to "the method of construction, or combi-

nation, by which the several parts of the jointed platform are put together; of the cylinder heads, and of the friction rollers." This combination in most of its parts, exists in numerous other endless platforms; the peculiarities of the one before us, ought, therefore, to have been pointed out, as upon these alone could any valid claim be founded.

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18. For a *Tin Oven*; Nathaniel D. Whitin, city of New York, October 10.

The oven, as represented in the drawing, is in the form of a common closet, with shelves; we are told, however, that it may assume various shapes, the claims made being to certain flat flues, and other appendages for conveying and regulating the heat, which are not, by any means, well described. The fuel is to be charcoal, and the furnace part, for receiving it, is to be so constructed that the combustion may, by an additional grate, be confined to the upper compartment of the shelved closet, or, when necessary, descend lower. The drawing is well enough as a picture, but it does not make the construction clearly known.

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19. For a *Cooking Stove*; Elnathan Samson, Pierpont, St. Lawrence county, New York, October 10.

This stove is to be used as an open stove, when desired; but, like many others, it has doors in front, by which it may be closed. The oven, boilers, &c., are clearly described, and well represented, but there is an entire absence of every thing like a claim. We are told, however, that the improvements will be obvious from the description, and to the patentee this may be the case; he has erred, however, in not enlightening others, by designating these improvements, as the law requires he should do; obvious as they are said to be, we cannot point them out.

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20. For a machine for *Hulling and Cleaning Clover and Timothy Seed*; Asa Burgess, and Herman Baldwin, Washington, Litchfield county, Connecticut, October 10.

Ten pages are devoted to the description of this machine, but our remarks upon it will be as brief as the specification is prolix. The feed is to be regulated by sliding boards, not differing essentially from such as are already in use. The seed is to be rubbed out by a revolving cylinder, furnished with points, or teeth; and below this there is a fan, so enclosed and constructed as to blow the chaff and dust away, without annoyance to the operator. The claim is sufficiently comprehensive, extending to many points in its construction, and also the situation in which it is to be placed in a building, for the purpose of blowing the chaff entirely out of it.

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21. For *Applying Hydraulic Power*; Robert Mills, Washington city, and Henry B. Fernald, Portland, Cumberland county, Maine, October 10.

The rising and falling of the tide is to be employed for the purpose of condensing atmospheric air, which condensed air is to be afterwards applied, as a motive power, to machinery. The mode of condensing consists in placing a reservoir in the water, which shall rest on the bottom. This reservoir is to be open at bottom, to admit the water, but closed at top, to retain the air; the top is to rise to a convenient height above the line of high water; at this line there must be a horizontal partition, or diaphragm, furnished

with valves, opening upwards, to admit the air as the water rises, and to retain it in the air chamber when it falls. This chamber is to be "provided with suitable *screw valves*, to admit of using the condensed air at pleasure;" it is to be "applied like steam." "In the falling of the water, there will be a vacuum created, or a tendency to that effect, in the air chamber, or room; and the atmosphere being admitted through a valve, opening inward, will rush with a force proportionable to the base of the air room, or chamber, and thus a power will be gained, in the falling of the tide, or water, which may also be employed to condense more air, or otherwise, by making the pressure of this air to work a wheel, or piston, as it enters the air chamber."

At p. 203 we noticed a patent, obtained, about two months since, by one of the above named gentlemen, for applying the rising and falling of the tide to the propelling of machinery, and showed that the plan then proposed was old, referring to a former patent for the same thing, and our remarks thereon. Although the mode there proposed is not, we think, likely to come into extensive use, there are situations where the power obtainable might be usefully applied; but if that now brought forward is intended as an improvement thereon, we are very certain that the thing will be "mended worse." To use the condensed air to advantage, would be an undertaking of great practical difficulty, and, in the present case, could not be effected, but by a very considerable loss of power; the patentees, however, have furnished us with no plan for doing this, and we will not attack windmills. We do not know, even, what they mean by "screw valves;" these are certainly novelties in mechanics. There is no point more clearly ruled than that a patent cannot be sustained for a principle, but only for the carrying of a principle into effect by certain means; but, in the case before us, no means are given.

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22. For a *Washing Machine*; John O. Geer, Norwich, Connecticut, October 10.

A cylinder is to revolve, like a barrel churn; numerous pins, about an inch in length, are to project from the inner surface of it, and a number of round rods are to extend from head to head, within the cylinder, at such a distance from the surface as to allow water to pass. There are also rollers turning on pivots, to be similarly located. "The pins, rods, or rounds, and the roller above described, are claimed as the special property of the patentee." We do not think it worth while to dispute this claim.

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23. For a *Machine for Making Staves*; George Pack, Sullivan, Madison county, New York, October 10.

This machine, it appears, is intended only for the jointing of staves, after they have been otherwise prepared, which jointing is to be effected by a long knife, reaching from end to end. The staves are to be first boiled, or steamed, to render them tender; they are then placed between jaws, embracing their ends, and advanced under the knife by a horizontal sliding table, moved by a rack and feed hand; the knife is to be forced down by lifters, operating under one end of a lever, to which it is attached.

The claim is to "the formation of staves from steamed, or boiled, wood, cut with an edge tool, or knife, after the manner, and according to the combination, above set forth," &c.

24. For improvements in *Constructing Rail-roads, and Regulating Cars thereon*; Roswell Bourne, Lancaster, Worcester county, Massachusetts, October 10.

A want of knowledge of what has been heretofore done in the construction of rail-roads, and also of the causes of the difficulties which it is proposed to obviate, are manifested in the specification of this patent. It is proposed to raise the outer rail on a curved rail-road, so as that "the inclination inward, or centripetal force, shall govern, or render equal, the centrifugal force, and thereby prevent the great friction of the outer wheel against the outer rail, which endangers the breaking of the axle, or wheel; your petitioner thus proposes to do away with the impediment, by graduation of the elevation of the outer rail to the angle [?] of the curve, and enabling the cars to maintain the same velocity of motion, as when moving in a direct course."

Rails have been elevated in the manner proposed, long since, for the purpose of lessening the friction of the flanch against it; but more effectual modes than this, founded upon more just principles, have been adopted, as will be seen by reference to James' patent, vol. iv., first series, page 317; Wright's patents, p. 270; and Stimpson's patents, pp. 269 and 278 of this volume.

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25. For a *Gravitation Churn*; Asahel Bacon, Windsor, Broome county, New York, October 10.

There is to be a weight wound up as a maintaining power to a pendulum, a train of wheels and pinions to regulate the same, and there is a claim to "the propelling of vibrating or dasher churns, by means of a weight, or weights attached to a gearing of cog, belt or band wheels, or all of them."

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26. For a *Rotary Steam-Engine*; Arnold Buffum, city of Philadelphia, October 10.

A cylinder twelve inches in diameter, and five inches deep, is to be made of metal. An oval block, twelve inches long, six wide, and four deep, or thick, is to be placed within the cylinder and two circular heads, half an inch thick, and exactly fitting the cylinder, are to be firmly attached to the oval block; an iron shaft passing through the centre, allows the block and heads to revolve. Two valves, each four inches square, are to be hinged on opposite sides of the cylinder, in which there are recesses to receive them, they being curved to adapt themselves thereto. The steam enters the chamber by opening against the centres of these valves, so that when they are closed by the passing of the oval block, no steam is admitted, but they are forced open by it as soon as the block ceases to press on them; there are, of course, two openings, properly situated, for the escape of the steam.

Those acquainted with the subject will at once see that the operation of this engine is dependent upon principles often employed in similar machines; in the arrangement we see nothing which is likely to render it superior to others of the same class, or to remove the objections generally existing against rotary engines. The claim comprehends the whole arrangement by which the machine is characterized.

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27. For a *Doffer*, for carding machines; S. Parkhurst, Providence, Rhode Island, October 10. (See specification.)

28. For an improvement in the mode of constructing *Grates, or Grate Bars, for Furnaces*; Jordan L. Mott, city of New York, October 14.

This patent is taken for a convenient mode of constructing grate bars, so that they may vibrate and tilt readily when required, and in such a manner that they require no filing, or other fitting, but are ready for use as they are delivered from the mould in casting.

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29. For an improvement in the manner of *Constructing Roads*; Thomas Earl, Burlington, Burlington county, New Jersey, October 14.

The road is to be levelled, then covered with gravel to the depth of two inches, and upon this tar is to be poured regularly; sand is to be spread over the tar, and allowed to remain until it is perfectly incorporated; in some cases the gravel may be omitted.

We have several times mentioned a like mode of making roads in this journal, and for years before its publication have pointed it out, and advocated it; the files of the patent office may be resorted to, to show that the present patentee is not the first inventor. To us it was suggested by the accidental staving of two barrels of tar on a common road, about twenty years ago; the place is a great thoroughfare on the main mail route through the United States, and we believe that the spot now remains apparently unimpressed by the passage of thousands of heavy vehicles.

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30. For an improvement in *Cast Iron Window Sashes*; James S. Stoddard, Macedon, Wayne county, New York, October 14.

The improvement claimed consists in casting the stiles, and top and bottom rails hollow, by which improvement the muntins and uprights are preserved from cracking in the cooling of the metal.

The foregoing claim may be good, but we doubt it. Cast iron sash have been extensively used in England for many years, and it would be strange if for the purpose above named, and that of lightness, the stiles and rails had not been cast hollow, or so narrow as to give them the same substance with the muntins; had we made a pattern for casting sash, we should not have needed instruction or admonition on this point.

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31. For improvement in the *Transshipment of Merchandise, on Canal and Rail Road Lines*; James O. Conner, city of Philadelphia, October 14.

This improvement consists in the construction of water-tight boxes, capable of holding about three tons of ordinary freight, and so shaped that they shall fit into canal boats, and also form the bodies of cars for transportation on rail roads. The boxes are to be lifted from one vehicle to the other, at the places of transshipment, by means of powerful cranes.

The claim is to "the principle of using large boxes, or car bodies, fitted to the interior of open canal boats, which boxes are to contain goods, or merchandise, for transshipment on rail roads, and on canals, without separating the contents of the boxes, or car-bodies."

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32. For improvements in *Hanging Carriage Bodies*; Henry Pace, Senr., Cincinnati, Hamilton county, Ohio, October 14.

Various modes are described of carrying into effect the proposed plan, of

hanging the bodies of carriages, the description of them being given at great length, the following constitutes the claim.

“*First.* To attach as many props and levers, of the denomination of ‘the lever of the first kind,’ as may be required for the use of any vehicle, or carriage, drawn or propelled by animal, steam, or other power. One prop for each lever may be fixed on any part of the running gear of the carriage that may suit its use or form, the lever to work free; the fulcrum to be placed at any part of the lever between the weight and the power, at the option of the builder.

“*Secondly.* To attach one or more springs, or other applicable power, to each lever, one end of each spring, or springs, to be affixed either to the bottom of the body, or bed, or to the running gear; and the other end of each spring, or springs, or other power, to be attached to the end of the long arm of the lever so as to work free, or to the running gear.

“*Thirdly.* To attach the ends of the short arms of all the levers to the body shackles, or to the body, or carriage, (which is the weight) so that the levers and springs may work free when the carriage is in motion.”

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33. For a *Turning Lathe, to turn Rake Staves, Hoe Handles, &c.* James Haven, Newport, Sullivan county, New Hampshire, October 14.

If there is any thing really new in this lathe, the patentee has not enabled us to discover it; the object proposed, that of varying the form of the handle, or other article turned, according to a pattern, is a thing well known. The specification, without the aid of a good drawing, is insufficient for the intended purpose; and that which is called a drawing serves only to “make darkness visible.” At all events, a lathe which would turn such handles most perfectly, may be constructed without violating the rights of any one.

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34. For *Running Gears for Rail Roads*; George W. Cleveland, city of Baltimore, October 14.

The object of this invention is to admit of the vibration of the axles of the wheels, in such a manner as that the latter shall always conform themselves to the curvature of the road. Each wheel has its distinct axis, there being a centre pivot to sustain the end of each, which inner ends revolve in a vibrating bar, allowing the axis to vibrate horizontally. The outer ends of the axles run in bearings which conform themselves to the motion of the inner ends of the axles. The tread of the wheels is to be perfectly flat, without any cone, or rise, towards the flanches, and it appears that the wheels are to conform themselves to the direction of the rail by the action of the flanches upon them; a very short time will, we apprehend; demonstrate the worthlessness of this plan.

The particular construction of the parts require the drawing for a proper explanation of them. Upon these the claims are founded, and are also made to any other way in which “they may be constructed, so that by means of the same principles of action, the vibration of the semi-axles at their inner bearings, may be caused and regulated, so as to preserve the parallelism of the wheels, and permit them, by means of their flanches, to conform to the course of the rail-way.”

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35. For a *Stove for Burning Anthracite Coal*; Dennison Olmsted, New Haven, Connecticut; first patented, November 5, 1834; patent surrendered, and reissued, October 14.

The original specification of this patent is given at page 407, vol. XV; all that is further required, therefore, are the claims as now made, which are, 1st. Bringing the surfaces destined to absorb the heat, and transmit it to the apartment, so near each other, as to cause the heated volume of products from the chamber of combustion to come more closely into contact with said surfaces than has heretofore been done in structures more or less resembling this. 2d. Introducing into the apartment a continual current of warm air, by means of the air pipe, which admits cold air into the hollow space within the inner figure of the radiator; and this volume of air being rarified by heat within said space, that is, chiefly by circulating on the surface of said inner figure, flows out above, and is thus communicated to the apartment. 3d. Employing partitions, as before described, by means of which the said heated volume is made more effectually to traverse the absorbing surfaces.

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36. For *Gimblets*; Orville B. Percival, East Haddam, Connecticut, October 14,

In this gimblet the pod is extended down to the end, or point of the screw, so that the threads are entirely on the back of it, the screw part itself forming a cutting edge, by which means it enters more easily into the wood, turns more freely, and with less than the ordinary tendency to split the stuff. Augurs, it is said, may be constructed on the same principle. From the specimen we have seen, we think that this gimblet possesses all the good properties ascribed to it.

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37. For a *Washing Machine*; Henry Ault, Philadelphia, Monroe county, Tennessee, October 14.

A fluted cylinder is to revolve in a trough, and between this and rollers below it, the clothes are to be passed, by turning the cylinder, the gudgeons of the latter resting upon springs, and being drawn down by placing the foot upon a treadle. After they are cleaned, the clothes are to be pressed by passing them between rollers, the uppermost of which, also, may be borne down by means of a treadle.

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38. For an improvement in *Fire Arms*; Samuel Ladd, Waltham, Middlesex county, Massachusetts, October 14.

This improvement consists in "overlaying fire arms with tin, or some compound metal of a similar nature, and thereby preventing the same from corroding with rust."

We do not believe that this process will ever come into general use, as the bright surface of the tin would be more objectionable than that of iron, which it has been found desirable to remove by bronzing.

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39. For a Machine for *Cutting Felloes for Wheels*; John S. Brown, and Jacob J. Barker, Phillips, Somerset county, Maine, October 14.

We are told that this patent is taken for improvements upon a patented machine, of which the above named applicants do not claim to be the inventors. The original machine is fully described, but nothing is said respecting who invented it. The felloes are to be cut from plank by cutters projecting from the face of a segment wheel. The whole arrangement of the apparatus is given with sufficient clearness, but there is no summary of the things claimed as novelties. The right of the present patentees must rest, if they have any, upon their having become the possessors of the

original patent, of which we know nothing. The improvements being matters of mere detail.

40. For a *Burr Stone Coffee Mill*; David Richmond, McArthurs-town, Athens county, Ohio, October 14.

The claim is to "the making the bed and runner, in mills, of burr, or other stone, instead of iron, for grinding coffee, pepper and spices." We are satisfied with iron and steel, and doubt very much our ever seeing reason for changing them for stone in our coffee-mill.

41. For a *Machine for Cutting Felloes*; Winslow, Braley and Melzar L. Worthley, Phillips, Somerset county, Maine, October 14.

The machine here described is like that mentioned at No. 39, and we learn at the Patent Office that it is the one alluded to in that article. The only difference in them is in the mode of holding the timber to be operated upon, which Messrs. Brown and Barker think they have improved.

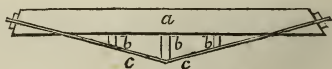
The patentees have not made any claim; we think, however, that there is sufficient novelty in the machine, upon which to found one.

42. For *Bridges and Viaducts*; Richard T. L. Witty, Lowell, Middlesex county, Massachusetts, October 14.

We really do not understand what is meant in certain parts of the specification of this bridge; but we will afford a chance of doing so to others, by giving the whole substance of it. "I combine the lateral thrust or pressure of a beam to the catenary curve, which said curve may be formed of rods, wrought iron or other metal, and of chain or rope, &c. But I prefer rods of wrought iron. The curve of iron must be stretched from end to end of a beam of wood, and firmly bolted thereto, and passing over stauncheons or other supports of wood or iron fastened to the beam, which said supports may be placed at suitable distances under the beam to form the catenarian curve, and the more firmly to retain it in its place. By this arrangement a very considerable strength of beam may be obtained for the making of bridges over rivers, canals, &c. and for the formation of viaducts to carry over rail-ways, in the construction of piers for docks or harbours, and for public buildings where considerable extent of beam may be required."

What is claimed are the invention, improvements, or methods, of making beams sufficiently strong for the formation of bridges, so as to extend them over rivers of great width, &c. and by heading the said beams with iron shields for that purpose, and to hold firmly the iron rods.

In the drawings, the *catenarian curve* is a straight beam, the *lateral thrust* of which is to be employed by the patentee; the accompanying sketch exhibits the manner of trussing a beam to form the said catenarian curve, as the patentee calls it. *a*, the beam, *b b*, the stauncheons, *c c*, the iron rod.



43. For a *Spark Suppressor*; Haut C. Wiatt, Weldon, Halifax county, North Carolina, October 15.

This apparatus is to be used on locomotive or other steam engines. It consists principally of two tubes, one covering the other, and exceeding it in diameter about four inches; the inner tube is the chimney, the space between it and the outer is the reservoir into which the sparks are to fall; the outer tube is to have a cap with small perforations, allowing the smoke to escape, but detaining the sparks. The outer tube is made to raise and lower by means of a lever, for passing under bridges, &c. The claim is to this general construction.

44. For a *Cooking-Stove*; Horatio B. Wade, Cincinnati, Ohio, October 17.

The claim made is to "the manner of forming a fire chamber in a permanent and fixed situation, extending from one end to the other of the stove: and the application of the movable hearth to the door thereof, being an improvement upon the stove heretofore patented; having a movable fire chest, and without any hearth.

45. For improvement in *Anthracite Coal Stoves and Grates*. Patented October 25, 1832. Patent surrendered and reissued under an amended specification. Eliphalet Nott, Schenectady, New York, October 17th, 1835.

This stove was noticed, when first patented, at page 233, vol. XI, and to this notice we refer the reader, not deeming it requisite to make any remarks in addition to those there offered.

46. For *Preparing Skins for Tanning*; John C. F. Saloman, Reading, Berks county, Pennsylvania, October 17.

Instead of applying dung, after the skins have been limed to remove the hair, some diluted or weakened acid is to be used "in about the following proportions. To every ten gallons of water add two and a half ounces of concentrated acid. The skins are then immersed in this diluted acid, and occasionally taken out and washed in pure water" until the lime is dissolved out.

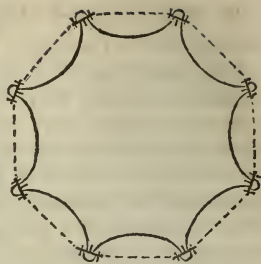
This specification is defective in not pointing out the kind of acid to be employed, as this is a point of no mean importance; it should be one which forms a soluble salt with lime, such as the muriatic. "Two and a half ounces of a concentrated acid," is also a very loose mode of giving directions, as different acids are not equivalent to each other under equal weights. The process, we have no doubt, is a good one.

47. For a *Safety Steam-Engine Boiler*; John C. F. Saloman, Reading, Berks county, Pennsylvania, October 17.

The claim under this patent is to "the principle of constructing boilers with inverted arches, so arranged as that their convex surfaces shall resist the pressure of the steam; and the surrounding of the boiler so formed by a cylindrical or polygonal casing, forming a chord to each arch the whole length of the boiler, and thus preventing the spring of the said arches; whilst at the same time the spaces between the cases and the arches thus formed, may serve as fire-places and flues for generating and conducting heat."

The sketch in the margin shows a transverse section of the boiler. Not only is the body of the boiler to consist of arched segments, rivetted together at their edges, but the heads also are to be concave inwards, so as to be pressed on by the steam in the manner of a dome.

Such a boiler would have a much less capacity in proportion to its weight, than one of the cylindrical form, and there would scarcely be a single point within it which, by yielding to the internal force, when not sufficient to rupture it, would not thereby enlarge its capacity.



The arched form, in a malleable, flexible substance, such as iron, will not operate in the same way with the stones in an arch of masonry; every indentation in the metal is a commencing point at which it may give way, and be followed by all the parts which surround it. Besides this, we see not how the places of juncture exposed to the action of the fire, and the metal forming the chord of the arches thus exposed, are to be kept from heating, and burning out. The thing at first view, is specious in its appearance, but it will not stand the test of examination; or the searching one of fire.

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48. For a *Plough*; Junius S. Tefft, Amherst, Erie county, New York, October 17.

The claims are to "the manner of constructing and using the standard; of applying the landside plate, and the general combination of the parts."

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49. For a *Washing Machine*; Isaac Spicer, Norwich, New London county, Connecticut, October 17.

A square box is to be made to revolve upon gudgeons; in a trough, within this box, there are to be pins projecting inwards; the claim is "to the construction of a machine in square."

Such square box washing machines have been long since patented, and are well known.

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50. For *Glass Knob Screws*; Orrin Newton, Pittsburgh, Pennsylvania, October 17.

We are informed that "in the manufacture of this kind of knob screws, the head is cast in a mould on to a wire headed shank, in order to secure the *cast* head more firmly on; the sample herewith sent is made of a compound of block tin and copper, but may be made of any compound that may be cast in a mould; the great advantage of this kind of screw over all others is, its being easily cleaned, and always retaining its original colour, and is more quickly made;" nothing further is said upon the subject, yet, something more is evidently required; what information "the sample herewith sent" will afford to those who see the foregoing description, or who obtain copies of it from the office, cannot be seen; there ought to have been a drawing, as this shank head, and the casting upon it, admit of drawings, in which case the law requires them.

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51. For *Cement for Cisterns*; William N. Carson and George Roberts, York, Livingston county, New York, October 17.

The following is the whole description. "Nine parts sand, three parts water-lime, one part plaster paris, and one quart muriate of soda; mix with water into a cement; to be applied to holes dug in the earth of any dimensions, for the purpose of holding water. What we claim as our invention is the addition of the plaster of paris and the muriate of soda (common salt) to the other articles."

The use of common salt, and of plaster of paris in such cements is not new, nor do we believe it to be of any use, as good hydraulic cement, made of the best water lime and sand, needs no improvement.

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52. For an improvement in the *Machine for making Biscuit and Crackers*; Thomas Havener, and Thomas H. Havener, city of Washington, October 17.

This machine differs in a very trifling degree from others before used for the same purpose; the dough is to be rolled out between two metallic or wooden rollers, whence it passes on to an endless apron, carrying it under cutters and dockers worked up and down by a crank motion; the crank shaft standing above a sliding frame, or gate, to which the cutters are attached. On one end of the crank shaft there is a fly-wheel, and to this is attached a rod and feed hand, which operating upon a ratchet wheel, gives motion to the lower of the first named rollers; a toothed wheel on the axis of this roller acts upon the other parts by means of suitable gearing.

The claim is "the general construction of the above described machinery, with the arrangement of the several parts as described, but *particularly* the before described *ratchet or feeding wheel*, and *hand*, worked from the axis of the fly-wheel;" which claim is certainly much broader than the invention, the general construction, as before remarked, not being new; the part *particularly* claimed is a well known mode of communicating motion in machinery, and standing alone, is entirely without novelty, yet like other known modes of communicating motion, it might derive the requisite character by its making a part of a new invention.

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53. For an improvement in *Calendering Cloth*; Zenas Bliss Johnston, Providence county, Rhode Island, October 17.

The improvement here patented consists in the addition of a roller above the three ordinarily used in calenders, by the aid of which additional roller the cloth is twice glazed in its passage between the rollers, thereby preventing the necessity of performing the operation a second time. In the ordinary calender, it is said that the boxes in which the gudgeons of the top roller run, last generally but sixty days, the weight having to be applied on them, whilst by the new arrangement, in which a large roller with a slow motion receives the weight, the boxes will last for two years.

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54. For *Covering Buildings with Metallic Plates*; Phineas Burgess, Brooklyn, New York, October 17.

"The principle of this improvement consists in the lapping of the sides of the strips together with lap string pieces, with or without ribs, substantially as described." Were we to give the whole description, it would not afford a clear idea of the mode adopted by the patentee, without the aid of the drawing. We could make it intelligible by a verbal description alone, but cannot afford the space required. The object, of course, is to allow of the unobstructed expansion and construction of the metallic plates.

55. For a machine for *Cutting Crackers and Soda Biscuits*; William R. Nivins, city of New York, October 17.

An upright frame sustains the cutter which is to be worked up and down by the action of a descending weight, operating by means of a rope and pulleys, with a regulating wheel like that used in the common English roasting jack, all which is well enough shown. The patentee informs us that what he claims "is the movement of said machine, being entirely different from any other hitherto known."

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56. For a *Machine for Cleaning Feathers*; George Reynolds, East Hartford, Connecticut, patented February 17th, 1834; patent surrendered and reissued, October 17th.

We described this machine in due course, page 176, vol. XIV. The object of the surrender was to make a claim, a thing entirely omitted in the first patent; it is as follows. "I do not claim, as my invention, the cylinder, the shaft, the pins, or indeed any several part of the machine taken by itself; but I do claim as my invention the combination of the several parts of the machine as described, and applicable to the particular objects aforesaid, and the manner of communicating the heat to the feathers by means of the revolving of the cylinder, presenting every side to the fire in rotation, and communicating the heat to every part of the feathers, as they are kept continually in motion by the dressing pins and revolving of the cylinder, and not liable to burn, or be overheated by continuing too long in one position."

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57. For a *Planing Machine*; Reid R. Throckmorton, city of New York, October 22.

This planing machine is very much like that patented by the same person, on the 6th of October, see No. 4. A segment of a circle is to be suspended above the platform on which the board to be planed lies; from the face of the segment project four knives or cutters, the plank resting upon an iron bed, and being carried forward between rollers. The pendulous segment is to be made to vibrate backwards and forwards by a crank, and shackle bar. The claim is to "the peculiar construction of the plane and side cutters, moved by slides or guides and cranks, and resulting in a combined motion, reciprocating, rectilinear, and partly circular, in one operation, by connecting the end of the plane; by means of its handle, to a crank, or any other circular motion." The side cutters mentioned are, as in the former patent, for jointing, tonguing and grooving, and are to act like the upper segment. The remarks which we made upon the former patent, we should be disposed to reiterate, with the exception of acknowledging a little more clearness in the details, in the new specification. The present ought to have been taken for an improvement on the former; as it is, the two are essentially for the same thing, and both cannot stand.

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58. For an improvement in the *Art of making Bricks and Tiles*; Benton P. Coston, Sterling, Wayne county, Pennsylvania, October 22.

This patent is not obtained, as the title indicates, for an improvement in the art of making bricks and tiles, but is for a machine for mixing, moulding, pressing and delivering bricks. The description, like the machine, is rather complex; the drawing is referred to throughout; a number of individual claims are made; and to these is added a claim to the general ar-

rangement and combination. A copy of those claims would not be understood without the drawings, it would show, however, that they are not very limited in their character.

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59. For a *Circumferenter, or Surveyor's Compass*; Samuel R. Miller, Port Royal, Frederick county, Virginia, October 22.

The claim made is to "an improvement on Francis Whitelly's compass, and consists in the arrangement of the several parts of the instrument described for taking angles."

The description is very imperfect, and the claim omits entirely to tell in what the improvement consists, an omission which, from the demands of the law, must be fatal. Who the Mr. W. is, whose compass has been improved, we do not know. It appears, however, from the specification and drawing, that the instrument here patented has a graduated semicircle, furnished with sights fixed upon arms on the chord of the semicircle produced. The needle is on a fixed arm, which is pointed, the point lying on the graduations of the semicircle, which latter, of course, moves with the sights, the degrees being read off at the point of the fixed arm.

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60. For an improvement in the *Manufacture of Tubes and Hinges*; William Shaw, Buffalo, Erie county, New York, October 27.

The machine intended to be described is one for bending sheet metal to form the tubular knuckles of hinges; the description is a very imperfect one, and there is not any claim made; we think, however, so far as the materials before us will justify an opinion, that the machine is sufficiently original to be claimed as a whole. The sheet metal is to be passed in between two blocks of steel, and held in its place by a tightening screw; when, by turning a crank, the end of it is bent round a pin, which pin is to be pushed out by placing the hand upon a lever, thus forcing up a round punch, or wire, for that purpose.

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61. For a *Morticing and Tenoning Machine*; John McClintoc, Chambersburg, Franklin county, Pennsylvania; patented October 8th, 1827; surrendered and reissued October 27.

The original patent was without any claim; it, however, described several things which have been claimed by others in patents subsequently obtained. We cannot now institute an enquiry into the originality of this and the other numerous morticing machines which have been patented at various times. The present claims are to the construction of the part which holds the chisel; the manner in which it is worked; the rack and pinion, that is the chisel rack and wheel; the mode of reversing the face of the chisel; the sliding table for bringing the pieces to be wrought into the proper place, the box which holds the stuff, and the manner of moving it; the round tongue on the chisel; the cutting sockets for Venitian shutters; the four-sided chisel; the double-cutting chisel; the treble-cutting chisel; the two-faced chisel; and the operating by treadle and spring.

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62. For *Obtaining a Power for Propelling Cars, Boats, &c.*; Alexander McGrew, Cincinnati, Ohio, October 27. (See specification.)

63. For a *Machine for Sawing Stone*; Daniel Bunnel, Zenia, Greene county, Ohio, October 27.

Saws are to be strained on frames, and fixed so as to run with a carriage having wheels upon suitable ways. The frames are to be moved by a crank motion. We are sorry that the patentee has omitted to tell what he claims, as we are entirely at a loss on this point, the whole, so far as we can perceive, being quite old.

64. For an *Apparatus for Boiling Sugar under a vacuum*; John Steele, Jr., city of New York, October 27. (See specification.)

65. For an improvement in the *Stone coal Stove*; Philip Benedict, Lancaster, Lancaster county, Pennsylvania, October 27.

This patent is said to be for an improvement on that of February 27th, 1830, noticed at p. 306, vol. v. The specification of the original patent was very obscure, and the present one is equally liable to the same objection; there is no other claim made than what is comprised in the information, that "the improvement consists in the lower oven, and manner of fixing the cylinder," neither of which are clearly described.

66- For *Ovens*; Jacob Baldwin, city of New York, October 27.

This patent is obtained for what must be esteemed a magnificent affair, as not only are ovens to be heated by anthracite coal, but, by means of the heated air, or *gas*, arising therefrom, houses and hotels, of the largest size, are to be warmed and *lighted*. "The inventor believes that the general use and application of his improvement will save our large cities from the repeated and heavy losses by fire, which from time to time occur;" and most assuredly he is correct in the conclusion, that, if they make all their fires by burning anthracite, in ovens of stone, or brick, and use no other light than that obtained from the gas arising from it, there will be little danger from the fire, and none from the lamps. The oven is to be built like a common bakers' oven; in one corner of it there is to be a grate, upon which the coal is to be laid and ignited, there being a draught hole beneath it. A flue, furnished with a damper, is to carry off the gas, which may be conducted wherever it is required for heating, or *illumination*. Upon these points there are, most unfortunately, no directions given, and we fear, therefore, that those who attempt to carry the plan into operation, especially the latter part of it, will *grope their way in the dark*. There is not any claim made.

67. For *Cutting Boots, Bootees, and High Laced Shoes*; Josiah T. Buck, New Canaan, Fairfield county, Connecticut, October 27.

We think that it will require a "cunning workman" to cut uppers for boots, &c., according to the proposed plan, without further directions than those given in the specification; all of which is comprised in the information, that the measure of the foot and leg are to taken in the mode now practised, the measure is to be laid on the leather, or cloth, to be cut; "when the upper for a boot is cut, it is but one piece of leather, with a slit on the vamp, and a projection for the top of the boot, making but one seam to close, and that a circular seam, running near the fore part of the boot, and ending at the bottom of the vamp, near the counter." There is neither a claim, nor drawing.

68. For a *Horse Collar Machine*; Caleb Angevine, city of New York, October 27.

The machine described is for blocking horse collars, a purpose for which several patents have been obtained within a year or two. A block, in the proper form, is to be bolted on to a bench, and a rope, passing round the collar, draws it to the block, said rope being wound round an iron shaft, turned by a wheel and pinion at one end of the bench. The patentee claims "the application of the cog wheels, cylinders, or shafts, hand crank, bolting the collar on the bench, hand lever, rag wheel, and stop, or catch, all as set forth in the specification." He probably might have extended his claim to the pair of hands by which he turns the crank of the pinion wheels.

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69. For *Moulds for Loaf Sugar, &c.*; Charles Duncan, Williamsburg, Kings county, New York, October 27.

A concave mould, or chuck, is to be made, and fixed upon a vertical shaft, which is to revolve like a potters' wheel. It is proposed to form the inside of this mould, or chuck, of plaster of Paris. The prepared clay for making the sugar mould, is to be laid within the concave, and a *former*, of the shape of the inside of the mould, is to be made to descend within it, so as to shape and smooth it. The specification, though verbose and involved, may, nevertheless, be sufficiently well understood to enable a person to carry the plan into operation. There is no claim.

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70. For a *Machine for Propelling Machinery*; David Russell, Tuscumbia, Franklin county, Alabama, October 27.

This is called "Russell's Power Motion Machine," and we suppose that it is intended to gain power, in some way, but how, we are not told, and cannot discover. A circular platform of wood, which is a flat ring, two feet wide, twenty in diameter, and four inches thick, rests upon steel springs; upon this platform, a heavy wheel is to roll, having a horizontal shaft geared into a vertical centre shaft, in the manner of some bark, drug, and other mills. The magic is, no doubt, in the springs, but we have no seer by us to unbind the spell.

The *combination and arrangement* are claimed, and we are told that "this machine may be used to propel all kinds of machinery, and may be propelled by steam, horse, water, or manual power."

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71. For a *Portable Saw Mill*; David Russell, Tuscumbia, Franklin county, Alabama, October 27.

Strange as it may seem, this portable saw mill, although invented by the patentee of the *machine for propelling machinery*, is to be driven by a horse, geared to a shaft, in the usual way. A frame is made, which is to be moved about upon wheels, and is to sustain the various parts of the mill, which has nothing peculiar in its construction, excepting it be that the saw is not to be strained in a frame, but the upper end of it is to be acted upon by springs, which are to aid in raising it, in conjunction with the operation of the crank at its lower end. Respecting the use of springs, we refer to No. 8, p. 327; this application of springs is not claimed, nor, indeed, is any thing, excepting "the combination and arrangement of the several parts," which, when there is no novelty, is a convenient mode of slurring the matter over.

72. For an improvement in the *Gearing of Rail-road Carriages*; William T. James, city of New York, October 27.

The claim made will explain the object of this invention; it is as follows. "The application of wheels to rail-road carriages, by separate frames, in such a manner that they will traverse such segments of a circle as is required to conform to the curves of the road; the centre of which circle being placed on that part of the frame towards the centre of the carriage." Arrangements very similar to this have been the subject of previous patents, and as applied to two separate carriages of four wheels each, is in use in Winans' patented double cars, on the Baltimore and Ohio rail-road.

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73. For a *Cooking Draw*; John C. Howard, Howard's Valley, Windham county, Connecticut, October 27.

A flat grate is to be set into a fireplace, and over this there is to be a drawer of metal, to slide in and out upon proper guides, or ledges. The claim "is a draw passing on grates into the chimney back, boiling and baking with the ordinary fire." The articles to be baked, boiled, or otherwise cooked, are to be put into this "draw."

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74. For a *Cotton Whipper*; Lucian Osgood, Pomfret, Windham county, Connecticut, October 27.

"What I claim as my improvement, and by which the whipping machine for cotton is facilitated, and rendered more effective than heretofore, is the placing the whip shafts of such machines obliquely, so as to form an angle with the horizon, of twenty-five, or such other number of degrees as may be preferred."

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75. For an improvement in the *Machine for Hulling Cotton Seed*; Anderson Miller, Washington county, Mississippi, and Thomas Laws, Jefferson county, Kentucky, October 27.

This machine is said to be an improvement upon that of Follet & Smith, but the whole arrangement of it is described, without any attempt being made to distinguish between the improvements, and the original machine. Much stress is laid upon the frame being of cast-iron, the gudgeons running in brass boxes, and all the parts of the machine being firmly made; there is also an eccentric roller described, by turning which the feed can be regulated. It should be recollected by the patentees, and by the purchasers of machines, or rights, that, excepting under the authority of Messrs. Follet & Smith, there can be no valid conveyance of the improved machine, any more than there can be of my house by a tenant, because he has improved it.

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76. For an improvement in *Making Ploughshares and Coulters*; Samuel A. Sperry, Ann Arbor, Washtenaw county, Michigan, October 27.

The iron is to be rolled, as nearly as may be, into the proper shape; it is then to be converted into steel, and the shares, or coulters, are afterwards to be forged into such forms as may be wanted. The right to do this is claimed, which claim is one of a very questionable character.

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77. For *Fastening Drawers*; Edward Brown, Lynchburg, Campbell county, Virginia, October 28.

We, some four or five years since, noticed a patent for a method of fastening a tier, or case of drawers, by one single lock, and mentioned a similar plan, by which we had, many years ago, effected the same object; the idea of doing so, however, we derived from a nest of drawers, imported from England; the plan now patented differs from those alluded to, but it is less simple, and not more efficacious. A rod is to extend up from the bottom to the top of the case, in a groove in one of its ends; this rod turns on pivots, and has a number of leaves projecting from it, equal to the number of drawers; when the drawer which has the lock on it is pushed in, it turns this rod, and brings the leaves to bear on recesses, or holes, in the sides of each of the other drawers. The claim is to the manner described of effecting this object.

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78. For an improvement in the "*Circular Revolving Tenter Bars*;" Stephen R. Parkhurst, Worcester, Worcester county, Massachusetts, October 28.

We described the circular tenter bars at p. 19, vol. xvi., and the present patent is obtained for improvements thereon; these consist, mainly, in those arrangements which were deemed best adapted to the employment of steam to facilitate the operation of drying the cloth. The cloth, instead of being wound spirally, is coiled round upon circular tenter bars, usually forming three thicknesses from a whole piece. The circular tenter bars have heads to them, which enclose the apparatus, excepting at the centre, and the cloth, when wound, forms the periphery of a drum. Steam is admitted into the apparatus through a hollow axis, and circulates around wheels, the rims of which are hollow tubes, and extend out nearly in contact with the cloth, thus heating the air within the drum. Vanes, to agitate the warmed air, are placed within the drum, and a rapid revolving motion being given to the apparatus, the air is driven through the cloth, and it is quickly dried. The claims made embrace the new arrangement of the machine.

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79. For a *Planing Machine*; Ira M'Laughlin, and Hiram Hill, Sunderland, Bennington county, Vermont, October 28.

We shall not attempt to explain the particular devices adopted by the patentees for giving motion to the different parts of the machinery, (and to which their claims are confined,) as the whole apparatus appears to us to be very inferior to several others for the same purpose. The planing is to be effected by a plane of the ordinary construction, and the stuff to be planed, together with the bench on which it lies, are to have a reciprocating motion, the plane being at rest. There, manifestly, must be an enormous waste of power, in thus moving the heavier body backward and forward, instead of the lighter.

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80. For a *Portable Stave Dresser*; Joseph Sweet, Murray, Lycoming county, Pennsylvania, October 28.

This patent appears to be taken for an improvement upon some other stave machinery, but what other we are not told. The staves are to be forced between knives, by means of followers, which have a toothed rack upon them, and are acted upon by a pinion. The knives are concave and convex, so as to dress each side of the stave, and as one follower rises, another descends, there being two sets of knives, or cutters. The claim made is to "the additional follower, and the mode of securing the guides." The

forcing of staves between such knives, by similar means, is not new, nor is it claimed. If there is an existing right to the original machine, the improvement must be used in subservience thereto; we think it probable, however, that it is common property, as such knives have been long used.

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81. For a machine for *Crushing and Grinding Corn*; Anderson P. H. Jordan, Madisonville, Monroe county, Tennessee, October 28.

The crushing is to be effected by a twisted bar of wrought iron, operating like that described by Oliver Evans, as used in mills for grinding plaster of Paris; from this twisted bar, the corn is to pass between a conical nut and shell, of the ordinary form. "The improvement consists in the uniting of the nut to the twisted bar, and upon this union the patent is claimed;" a union which may very well be dispensed with.

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82. For a *Cement for Forming Pillars, Plastering Houses, &c.*; Charles Clinton, Minnisink, Orange county, New York, October 28.

Limestone is to be burnt until about two-fifths of it is converted into lime; to four bushels of this, when cool, four pounds of pearl-ash, and three pounds of alum, are to be added, and the whole ground fine; the composition is to be put into open barrels, and to remain there until the lime is perfectly slacked, after which it is to be mixed with water to a proper consistence, and used as a hard finish for walls; when rubbed down, it is to look like polished marble. For outside walls, about one-third part of sand is to be added. The composition may be variegated in its colours by the addition of proper materials for that purpose, and a variety of modes are suggested for varying the ornamental appearance of it. "Blocks, pillars, &c., may be formed of the cement, and, when sufficiently dry, may be plastered as before directed, and polished." Such are the general directions given, together with several variations, which we do not think it necessary to notice, as no claim whatever is made.

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83. For a *Horse Power*; Asa Trahern, Henry Heberling, William E. Lukens, and John Heberling, Short Creek, Harrison county, Ohio, October 28.

This horse power is of the well known kind in which the animal, walking in a circle, is geared to a lever extending from a vertical shaft; at the lower end of this shaft is a crown, or bevil, master wheel, gearing into a pinion, or wallower, on a horizontal shaft, even with the ground. We cannot find any thing new in the affair; but the patentees claim "the eye of the master wheel and shaft, and the moving pinion, by which means, wood, pot metal, and iron, and, consequently, cost, are saved, and its utility greatly increased, whilst it is rendered much more portable." We are told that the master wheel "has a round eye, and runs on a round shaft." And the pinion by which the power is communicated at the outer end of a horizontal shaft, runs in a frame which may be moved round, so as to cause it to stand on any part of the periphery of the wheel which drives it. These, we suppose, are the things intended to be claimed by the four improvers of the horse power.

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84. For a *Hill Side and Horizontal Plough*; John W. Jordan, Lexington, Rockbridge county, Virginia, October 28.

The claim made is to "the *combination and arrangement* of the parts of the described plough, but particularly the *form* of the mould-board, and the

manner of reversing it, though no claim is made to the principle of revolving mould-boards." As respects "the *form* of the mould-board," it is said to resemble "two mould-boards of the M'Cormick pattern, (a right and a left hand,) united by their upper edges." There are numerous points of detail, showing, by reference to drawings, the particular manner in which the patentee constructs and connects the various parts of his plough, but nothing which bespeaks it superior to other hill-side ploughs, many of which have been patented.

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85. For a *Gridiron*; Kellogg Strong, Meriden, New Haven county, Connecticut, October 28.

This is a rotary gridiron, very much, in appearance, like those already in use, consisting, like them, of two parts, the lowermost, or stand, being used to support the rotary bars. The thing claimed in this is the making the rotary part, which supports the meat, of very narrow flat bars, which allow the gravy to run on to the bars of the stand, which are fluted, and lead to a common receptacle, or gravy cup, from which they all radiate; in consequence of this construction, we are told that the juices run freely to the reservoir, the current not being disturbed by the rotation of the upper part.

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86. For a *Machine for Cutting Saw Teeth*; Andrew F. Mervin, Muncy, Lycoming county, Pennsylvania, October 28.

The action of this machine for gumming saws, or cutting saw teeth, is so similar to that of many others, as to render it unnecessary to describe it, the main difference between them being in form only. The claims include parts which have no novelty, being to, "movable dies; the plate for holding down the female die; the screws and plate for regulating the stock; the regulator for determining the size and shape of the tooth, with the arrangement and adaptation of the several parts."

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87. For an improvement in *Pumps*; Joseph Redelsperger, Mansfield, Warren county, New Jersey, October 28.

We have frequently remarked, that when we meet with a patent for improvements in pumps, we expect but little that is valuable and new, and we are compelled to say that the one now presented to our notice does not contain any thing to exalt it above its fellows. In its general construction, it is a common double-barrelled forcing pump, the parts of which do not offer any thing new, excepting it be two or three complex modes of working the pistons, which will ensure an abundant portion of friction. The claims made extend only to "the combination and arrangement of the several parts of the pumps, as above described;" and which combination and arrangement, were we about to erect forcing pumps, we would most carefully eschew.

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88. For a *Rotary Pump*; Charles Peters, and Benjamin Deane, Poughkeepsie, Dutchess county, New York, October 31.

This rotary pump varies but little in its mode of action from others which have preceded it. There is to be a cylindrical case, with flat heads, and within this a smaller cylinder is to revolve, leaving an annular space between the two for the water chamber. Three valves are hinged, and shut into the inner cylinder, of which, when closed, they make a part of the periphery; they are forced into their places by a stop, or curved plane, which fills the capacity of the chamber in one point. When they pass this, they are

forced out by pins, radiating from the centre, and in contact with their under sides; the pins are operated upon by a fixed stationary cam, in the centre of the pump. The water is not to be delivered from an eduction pipe on the periphery of the outer cylinder, as is usually done, but from the centre of one of the heads; to enable it to arrive there, perforations are made through the revolving cylinder, under the valves, this cylinder being hollow, and supported by arms. This latter arrangement makes a prominent part of the claim, and, so far as we know, is new, and, the patentee thinks, very advantageous; we, however, are unable to discover whence its benefits are to be derived. An important thing in every pump is to change the direction of the water as little as possible, and certainly this is not accomplished by the mode of delivery proposed. In other respects, this pump is liable to the general objections to those on the rotary plan, resulting from the accuracy required in their construction, and which, if at first attained, is soon lost by wear.

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89. For a *Truss for Hernia*; Henry Reid, Augusta, Georgia, October 31.

We suppose, from the manner in which the application and use of this truss are described, that the patentee is a practitioner of medicine, as it displays both knowledge and judgment upon the subject to which it relates. The truss spring is, in all cases, to extend entirely round the body, and is to be furnished with two pads, one at each end, that which presses on the abdominal ring on the sound side being soft, whilst that on the ruptured side is to be of wood, adapted to the size of the patient, and in the form of a half egg, supposing it to be divided longitudinally. There is no claim made, but the patentee evidently proceeds upon the idea that springs passing round the body, and having a pad at each end, are novelties.

The patentee says that this truss "differs from Hull's and Marshe's, in the peculiar shape of the block by which the immediate pressure is made, and in the immobility of the blocks, and in the pressure being made by blocks, instead of pads, or cushions. It differs from Stagner's in having simply spring power, and that so adjusted to the parts as to retain its adjustment without the aid of belt, buckle, and straps, or any other means, except the spring power."

"What I claim as my own invention, and not previously known in the above described improved independent spring truss, is, that it passes from one abdominal ring, and maintains a permanently equable pressure on the soft parts above the brim of the pelvis on each side, without the aid of belt, strap, buckle, or any other appendages whatsoever; and I claim, also, the short curved spring passing from the groin to the umbilicus."

The patentee is in error in supposing that a truss spring passing entirely round the body, and having a pad at each end, is new; we have seen more than one of this kind; that patented by D. Weaver, of Baltimore, is described at p. 327, vol. xiii., where it is expressly stated that "the double spring is to be used whether the hernia be only on one, or on both sides; this latter truss has also two small pads near the middle of the spring, one to bear on each side of the spine; there is a hinge joint at the middle, connecting the double spring, and calculated to give extra freedom to its motion, which is, we think, a manifest advantage.

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90. For *Ladies Metallic Hair Combs*; Nathaniel Bushnell, Middletown, Middlesex county, Connecticut, October 31.

The comb described is to have the top made of tin, and the teeth of iron wire; the upper ends of the teeth are to be soldered to the plate, the edges of which are to be bent over to secure them in their places. The comb is afterwards to be painted in imitation of shell, or otherwise ornamented. Much is said about claiming and not claiming, which results, as we understand it, in there not being any thing new, excepting the manner of securing "the end teeth," which is a trifling affair, not worth describing, although worth patenting.

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91. For a *Tailors' Measure*; Frederick A. Fairchild, Columbus, Muscogee county, Georgia, October 31.

The claim made is to "the combination of the steel bands with the sheet-brass strips, by means of clasps, loops, and thumb-screws, adjustable together, and substantially as described."

The drawings of the steel bands, brass strips, and a number of graduated tapes, have a very formidable appearance, and seem sufficient to enable a surgeon to bandage every limb in a man's body. We take it for granted that the apparatus is a very perfect one, but cannot undertake to analyze it.

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92. For an improvement in the *Steelyard Balance*; Christian F. Dahl, city of Pittsburgh, Pennsylvania, October 31.

The improvements claimed consist, first, in giving the suspensions a single bearing, by allowing them to pass into a slot, or mortise, in the beam, instead of embracing it on each side; and, secondly, in placing a screw vertically at the back end of the beam, with a ball, or nut, on it, by the raising or lowering of which, the sensibility of the beam may be increased, or decreased. We are not aware that any benefit will be derived from having a single bearing for the suspensions; the patentee says that the friction will be lessened, but such is not the fact, as that will be proportioned to the load, without regard to the length of the bearing, supposing the workmanship to be good. The patentee speaks of the ball, on the vertical wire, as though it afforded the means of adjusting the beam, but its effect will be only to raise, or lower, the centre of gravity.

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93. For *Open Stoves, and Fire-places, for Warming Buildings*; Daniel Sutherland, Lisbon, Lincoln county, Maine, October 31.

This stove, or fireplace, is similar to those open stoves, from the top of which a pipe ascends, and passes into the chimney at any convenient height. In the case before us, there is to be an open and direct passage into the chimney in the ordinary way, and a pipe, or second flue, rising from the top of the stove. A valve, or sliding shutter, is so constructed that either of the flues may be closed by it, at pleasure, or both left partially open.

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#### SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a Patent for an improvement in the Rearing of Silk Worms; Granted to GAMALIEL GAY, Poughkeepsie, Dutchess county, New York, October 6th, 1835.*

To all to whom these presents shall come, I, Gamaliel Gay, of the town of Poughkeepsie, in the county of Dutchess, and state of New York, send greeting.

The hurdles for rearing and feeding silk worms upon, are, or should be, made on a horizontal, four sided frame, of convenient width and length, and bottomed with cane, or twine, either reticulated, or having interstices between each slat of the cane, or thread of twine; which meshes, or interstices, should be of such dimensions that the silk worm will lie and feed upon them, and the litter of the worms fall through.

Now, be it known, that I, Gamaliel Gay, have invented, and applied to use, a revolving apron, for receiving upon it, and removing, the litter of the silk-worms, which falls through the hurdles, as above mentioned. The specification of which new and useful invention, for receiving and removing the litter of silk worms, is as follows.

The revolving apron for a single hurdle is constructed by placing in a frame, or otherwise, at and immediately under each end of the hurdle, a roller, or cylinder, in length equal to the width of the hurdle; over these cylinders, or rollers, extending from the outside of the periphery of the one, over and around that of the other is affixed an endless apron of cloth, or other flexible substance, equal, at least in width, to the width of the hurdle. This apron being drawn tight around the rollers, and the ends fastened together, is made to revolve around both rollers, by turning them by a crank affixed to the axle of one of them, or by otherwise revolving the rollers. The endless apron being thus constructed, receives the litter from the hurdle as it falls through, which litter, by causing a semi-revolution of the apron, is removed from under the hurdles, and caused to fall in a heap at one and either end of the hurdles, and may be suffered to fall from the apron either upon the floor, or into a vessel placed at, and partly under, the end of the hurdle, and below the outer periphery of the roller.

In case two or more hurdles be placed in tiers, one above the other, the same apron may be used, in which case an endless and separate apron is required for each hurdle; but the best method, the most convenient and least expensive form of apparatus, and which I claim as a constituent part of my invention, is constructed as follows. Let there be rollers, or cylinders, affixed under each end of each hurdle, the same as in case of a single hurdle; to one roller, below the lower hurdle, attach one end of an apron, of the kind and proportionate width first above specified; let this apron pass under the opposite roller, over the roller next immediately above that, under the roller next immediately above the first roller to which the apron is attached, over the next above roller, and under the next opposite one; and so on according to the number of hurdles in the tier, until the apron reaches the last roller to which the apron should be attached, after adding to the length of the apron at least the length of one of the hurdles, which should be rolled upon the last mentioned roller. The apron thus passing under each hurdle, receives all the litter falling from each, which litter is discharged, part at one end, and part at the other end of the hurdles, by turning the first mentioned roller so as to wind over and around it a quantity of the apron equal to the length of the above hurdle, which winding causes an equal quantity of the apron to unwind from the roller to which the other end of the roller is attached; after the litter is thus discharged from the apron, the apron is, in part, to be again wound around the upper roller, as first above mentioned, so as to remain until the litter is again discharged.

What I claim as my improvement, and wish to secure by letters patent, in the rearing of silk worms, is the application of a revolving apron, or aprons, placed under the hurdles upon which the worms are fed, for the purpose of receiving and removing the litter falling from them; and this I

claim, whether the same be made exactly in the way described, or in any other, operating substantially on the same principle, and by which a similar effect is produced.

GAMALIEL GAY.

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*Specification of a Patent for a Doffer for Wool Carding Machines. Granted to STEPHEN R. PARKHURST, Providence, Rhode Island, October 10th, 1835.*

To all persons to whom these presents shall come, be it known, that I, Stephen R. Parkhurst, of Providence, in the county of Providence, and state of Rhode Island, and Providence Plantations, have invented a new and useful doffer, with corresponding rolls, for the wool card, called a finisher. Instead of a continuous cylinder, this doffer is composed of a set of wheels, or pulleys, of equal diameter with the common doffer, covered with a card in the same way, of three or four inches thickness at the rims, to revolve like the common doffer, placed upon their shaft, an inch, or an inch and a half, apart, and at a small angle and parallel with each other, and making such an angle with the shaft as that the spaces between may be fully compensated in their revolution, and the whole surface of the main cylinder be passed over by them; and their rims, or outer surfaces, must be parallel to their shaft, so as to conform to the surface of the main cylinder. Next, there is a set of pulleys, which I call division rollers; these may be about four inches in diameter, for a common doffer, of the same thickness with the spaces between the different rims, or pulleys, of the doffer, placed upon their shaft at the same angle, turned by a belt, or gear, placed before the doffer, with their shaft a little lower than the shaft of the doffer, and so placed that their outer edges will be a little within the rims of the doffer, for the purpose of keeping the wool on the different parts, or wheels, of the doffer, entirely separate, as it is taken off by the top rolls, hereinafter described. The next are a set of pulleys, or wheels, or rims, which I call the top rolls; they are equal in number to the different rims of the doffer, four or five inches in diameter; they may be a little less in thickness than the width of the different rims of the doffer, so that the division rolls may revolve freely between them, placed so as to revolve in contact with their correspondent rims of the doffer, for the purpose of taking the wool from it, and so placed as that they will so bear upon the shaft of the division rolls as to be turned by it. A comb, if necessary, may be attached to this doffer, to clear the wool from it. The wool taken from the doffer by these top rolls, kept in separate laminæ, or flakes, by the division rolls, drawn over the shaft of the division rolls, may be passed through a tube, or a belt, and then run on a spool, or spools; or, by a flyer properly placed, it may be at once twisted into a thread. By regulating the feed of the card, and the speed of the division rolls, the size of the roving, and of thread, i. e. the fineness of them, may be regulated, or adjusted, to suit the work required.

I claim as my invention, and not before known, the doffer before described, together with the top rolls, and division rolls, to correspond with it.

STEPHEN R. PARKHURST.

*Specification of a Patent for Obtaining a Power for Propelling Cars, Boats, &c. Granted to ALEXANDER M'GREW, Cincinnati, Ohio, October 25th, 1835.*

To all whom it may concern, be it known, that I, Alexander M'Grew, of Cincinnati, in the county of Hamilton, and state of Ohio, have invented, or discovered, a more economical mode of obtaining power for propelling cars upon rail-roads, boats upon rivers and canals, and effecting other objects, where such power may be wanted for the purposes of transportation, than has heretofore been adopted; and I do hereby declare that the following is a full and exact description thereof.

My improvement does not consist in the employment of any newly invented machinery, but in the using of such power from falls, or currents of water, or other natural or artificial sources of power, as has heretofore been allowed to run to waste, and employing the same for the purpose of condensing of air into suitable receivers; the elastic force of which condensed air is to be subsequently applied to the purposes herein designated. In numerous situations in the courses of canals and rail-roads, and of other roads and water courses, there are falls of water, waste weirs, dams, sluices, &c., the power from which, if economized, would be ample for the attainment of all the ends proposed by me; I bring this into use by taking the waste power from wheels, or other machinery already erected, or by erecting others where they do not already exist, using any of the known constructions of such wheels, or other machinery, as may be best adapted to the particular situations in which they are to be employed; these I connect in the ordinary way with the piston, or pistons, of condensing engines, constructed for the condensing of air, and force air thereby into suitable receptacles, or reservoirs, furnished with the requisite tubes, valves, or other appendages, by which they are adapted to the containing of the air thus condensed, and to the supplying of the same in measured quantities, so as to operate upon a piston for driving and propelling machinery, as high steam is now made to operate. The means of doing this does not require any description, being perfectly familiar to competent engineers. The air is to be condensed into one large stationary reservoir, and by means of a connecting tube and stop cock, transferred therefrom into other reservoirs connected with the vehicle to be propelled.

What I claim as my improvement in the art of propelling cars, boats, or other vehicles for transportation, is the employment of the waste power of water, wind, or other natural or artificial sources of power, to the condensation of air, in the manner, and for the purposes, hereinbefore set forth.

ALEXANDER M'GREW.

*Remarks by the Editor.*—It has been repeatedly proposed to drive railroad cars, &c., by means of condensed air, instead of by steam, and to erect stationary engines for the purpose of filling the requisite reservoirs, and we believe that the thing was attempted in England. Were there not serious practical objections to the plan, it would certainly present many advantages, but these are so weighty, that they are not likely to be removed. Among them is the perpetually diminishing power of the condensed air, as every stroke of a piston must lessen its elastic force; to graduate the quantity emitted from the reservoir, in proportion to this diminished force, would be very difficult; and, besides this, there ought, when the reservoir is

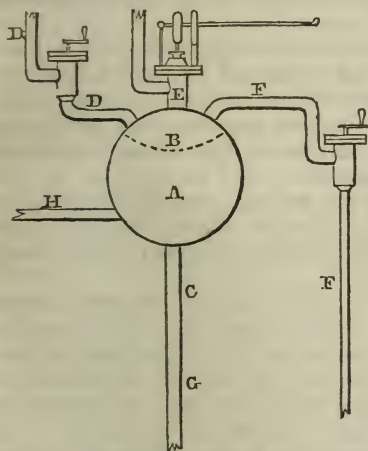
renewed, to be a pressure of several atmospheres above what is required in a steam boiler, or it will soon be so far exhausted as to be inadequate to the production of the intended effect, as they would have to be exchanged whilst under a pressure of two or three atmospheres.

The present patentee does not propose to remove the foregoing, or any other objection to the use of condensed air, excepting it be the necessity of erecting stationary engines to effect the condensation; and to accomplish this, he depends upon the employment of means which would generally be more difficult, precarious, and expensive; in many places, the means of condensation proposed to be used would not be found within many miles of the stations where the reservoirs would be wanted, and there are, in fact, but few situations where the means of applying waste power would not be a costly undertaking.

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*Specification of a Patent for an Apparatus for Boiling Liquids under a vacuum. Granted to JOHN STEELE, Jr., city of New York, October 31st 1835.*

To all to whom these presents shall come, be it known, that I, John Steele, Jr., of the city of New York, in the state of New York, have invented a new and useful improvement in the apparatus for boiling liquids, &c., under a vacuum, and that the following is a true and exact description thereof.



A, in the drawing hereto annexed, and to which I refer as part of this specification, is a large air-tight vessel, which may be made of any convenient shape, and of wood, or metal. B, is a colander, extending through the air-tight vessel A, in order to disperse a jet, or stream, of water into small drops, thrown in by the pipes D and F, which are constructed with proper cocks, or valves, for regulating the supply of water. E, is a safety valve. C, is a pipe of the proper length, the lower end of which is plunged in water. H, is a pipe from a steam boiler. In order to produce a vacuum, steam is let into the vessel A, through the pipe H,

until the vessels are completely blown through, when the pipe H may be shut. A quantity of cold water is now thrown on the colander B, by the pipes D, or F, which instantly condenses the steam, and forms a good vacuum. The condensation water falls out at the pipe C, G. A pipe from the pan, or still, is introduced into the large vessel A, or any pipe connected with it; consequently, a vacuum is formed in the pan, or still, so connected. The pipes D and F, may be supplied with water by means of a force, or of any other, pump, or they may supply themselves, if the location be convenient.

What I claim as my invention, and not previously known, in the above described apparatus, is the boiling of sugar, or any other substance, under a vacuum, without using an air pump to produce that vacuum.

In witness whereof, I have hereunto subscribed my name, this twenty-sixth day of August, in the year one thousand eight hundred and thirty-five.

JOHN STEELE, Jr.

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**Progress of Practical and Theoretical Mechanics and Chemistry.**

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*Report on the use of the Hot Air Blast in iron Furnaces and Foundries.*  
*By A. GUENYVEAU, Engineer and Professor in the Royal School of Mines.*

[Concluded from p. 139\*]

**II. APPLICATION OF THE HOT AIR BLAST TO CUPOLA FURNACES, TO SMITH'S FORGES, &c.**

The hot air blast appears to have been applied with great advantage, in England, in furnaces for remelting pig iron. The consumption of coke, per ton of iron, was reduced from 400 to 280 lbs., one ton of metal passing per hour. The blast was heated by an apparatus placed at the trunnel head. There are various advantages resulting from this application. The fusion of the metal takes place in about half the time required to melt it by the cold blast; it is thus less exposed to the injurious action of the blast, and while twice the quantity of iron can be melted in a given time, the quality of the material is better. It is further stated that the quality of the iron is improved by the melting, and that it is more easily cast, owing to its greater fluidity.

At Vienne, France, there are two cupola furnaces supplied with hot air. The apparatus is at the trunnel head, and consists of two bell-shaped vessels, through the interstice between which the draught is forced. This form of apparatus is decidedly bad, the alternate expansion and contraction of the parts renders it leaky in a very short time. The efficacy of the hot air blast is felt, however, even at this furnace.

In applying the heating apparatus at the trunnel head of furnaces, for smelting lead, copper, &c. care must be taken to protect the pipes from the sulphurous and metallic vapours, which, issuing from the furnace, would destroy them very rapidly.

The fan, or rotary, blowing machine is used in several establishments at Paris, Rouen, &c. for supplying cupola furnaces with air. This though a simple means of applying power, does not seem to be an economical one. Even when great velocity is given to the fans, the force of the blast is inconsiderable, but by increasing the opening of the blast-pipe, the quantity of air thrown in may be rendered very great. In one case at Rouen, by increasing the diameter of the tuyeres from 30 to 54 lines, the daily yield of the furnace was nearly doubled, and an economy of fuel (coke) of 20 per cent. resulted, the cold blast being used in both cases. At La Voulte the fan makes from 800 to 1000 revolutions per minute, and the pressure at the tuyere is only four-tenths of an inch of mercury. Three and a half to four inches is the ordinary pressure with other blowing machines. If the air were to be heated, this machine would be hardly applicable, as the friction in the tubes of the heating apparatus would tend materially to diminish the draught.

Unsuccessful attempts have been made both in England and France, to

\* Translated for this Journal, by Prof. A. D. Bache.

apply the hot air blast to bloomery furnaces. The causes of failure are, however, not known.

A similar application to finery furnaces, using charcoal as fuel, has succeeded. Mr. Combes states that at Lausen, (in Wirtemberg) the blast is heated by pipes below the hearth of a finery furnace, and has its temperature raised to 390° Fab. With the cold air blast, they used 40 cubic feet of charcoal to produce 200 lbs. of bar iron, and the weekly yield of the furnace was 6,000 lbs. Now, with the hot air blast, they consume 30 cubic feet of charcoal to the two hundred pounds of iron, or about one part by weight of charcoal, to one of malleable iron; the weekly yield is from 7,200 to 7,800 lbs. On several occasions the consumption of charcoal per 200 lbs. of iron was as high as 36 cubic feet, which the workmen attributed to their using pig iron obtained by the hot air blast, which they considered more difficult to refine than that made with the cold blast.

This last conjecture is opposed to the experience at Königsbrunn, where they do not consider iron reduced by the hot air blast as difficult to refine. The economy of fuel by this method of refining, has been rather more than one-sixth, and the loss in rendering the iron malleable is diminished. This successful result is obtained by using the hot air blast in melting the metal, while it is decarbonized by the aid of the cold blast. This method of operating has been followed with success at the finery furnaces at Creusot and Decazeville.

I was present at some trials made upon a catalonia forge by an association of iron masters of the department of Ariège. These were entirely unsuccessful. In the last of them the consumption of coal was not greater than with the cold blast, but the iron was of very inferior quality.

The hot air blast has been applied to the smith's forge with success. The iron was brought more rapidly to a welding heat, and the loss by oxidation was less than with the cold blast. There was no gain in the consumption of fuel. This method will probably be found useful in the working of steel, but no experiments have yet been made of a decisive character.

#### ON THE USE OF RAW COAL, OR OF WOOD, IN HIGH FURNACES, &c.

In order to produce a high temperature in a furnace, it is obviously necessary that the fuel should be consumed rapidly, and should not give off when heated, any vapours or incombustible gases, to carry off heat. The air thrown in by the draught contains four-fifths of its weight of nitrogen, which becoming heated causes a waste of fuel; if in addition to this, vapourizable matters are present in the fuel, the loss of heat is greatly increased. Charcoal, coke, &c. make such hot fires because their volatile parts have been driven off by previous heating.

In high furnaces wood has been used to advantage, even in the smelting of iron, while it has failed in low ones. In the former the fuel descends slowly, and after having its temperature gradually raised, reaches the part of the furnace in which the blast is most operative. At this place the highest heat is to be found, and here the principal chemical changes take place. Thus in fact the fuel is gradually dried and carbonized before it reaches the place of greatest heat. If it were otherwise, the working of the furnace would be very unsatisfactory.

Experiment has proved the position just taken, however liable to objection it may seem on the score of the high heat which may be supposed, in every furnace, much above the tuyeres. It was found in the Hartz, by trial in a furnace of twenty feet in height, in which lead and copper ores

were smelted, that the wood used as fuel came within six or eight inches of the tuyeres, without having been carbonized. The experiment was made by having small openings made at intervals in the stack, through which the progress of the operation could be examined. In this case the use of wood was abandoned, the furnaces being worked, as before, with charcoal.

A further proof of the same position may be drawn from the fact that raw coal, although substituted for coke, with advantage, in some high furnaces, has not been used in cupolas.

It is then absolutely necessary that the wood, or coal, should be converted into charcoal, or coke, before reaching the reducing part of the furnace. When this does not occur, and this is proved to be sometimes the case, the working of the furnace is unsatisfactory. The nature of the coal will produce different effects in the same kind of furnace. Thus at Alais a gradual deterioration in the working of the furnace resulted from the use of raw coal; at Creusot it was found necessary to mix the raw coal and coke in nearly equal proportions; in Scotland the hot air blast is required to enable them to use raw coal, while in Wales and at Decazeville they use raw coal with the cold air blast. The effect of the hot air blast is doubtless to facilitate the carbonization of the raw fuel. To use wood for the smelting of iron, even in high furnaces, it has been found necessary to dry it before charging with it. This is true both in the Russian furnaces, and at Plons, in the latter of which the hot air blast is used, and the wood is mixed with charcoal. It should be observed further, that resinous woods, easily charred, have been the only ones hitherto tried.

This reasoning shows also why the more or less perfect roasting of an ore, the more or less moist state of the materials of the charge, the more or less complete carbonization of the wood or coal, produce such important effects, even in the largest furnaces. It is plain that the temperature just above the point when the ore is reduced is low, since coal, or wood, is not charred, and that to this we must look for the reason why it is so difficult to use these combustibles in the raw state.

M. Lampadius, of Freyburg, in his essay "on the use of combustibles in their crude state,"\* has shown how necessary it is to heat the wood, or turf, to a point near to that in which it begins to carbonize, before using it as fuel. He remarks that the cost of transporting wood or turf being, of course, much greater than the freight upon the charcoal from them, will prevent their use in many cases. Thus if it be supposed that there is a gain of twenty-five per cent in the quantity of charcoal, by using wood not carbonized, as was the case in the Russian furnaces, the balance would at Freyburg, be against the use of the raw material, on account of the cost of transportation. M. Lampadius concludes that when the material is at hand, or the cost of transportation low, uncarbonized wood may be used to advantage, in high furnaces, for smelting iron, if it has been duly dried; a result due to the heat given out in the combustion of the gases driven off from the wood, and to their reducing power.

The cause just assigned seems to me insufficient to explain the very great economy sometimes resulting from the use of the raw material; I consider the effect mainly due to the mode of carbonization, by which a much larger per centage of the carbonized fuel results than by the ordinary methods. The volatile parts of the fuel are driven off by the heated and

\*Erdmann's Journal of Chem. and Technology, vol. XII. 1831.

incombustible gases passing through it, and there is no waste, by combustion. Being carbonized slowly, uniformly and without sensible waste, the greatest useful effect must result, and it is easily understood why a given weight of dry wood, or coal, may when thus circumstanced, yield a fourth, or even a half more charcoal, or coke, than it would by the ordinary method, and thus may be competent to reduce a fourth, or half more ore.

It must be admitted however, that this explanation does not account satisfactorily for the very great advantage found in the use of raw coal, in the high furnaces of Scotland, with the hot blast, and at Decazeville with the cold blast. At Decazeville, coal more than replaces an equal weight of coke. Thus one part by weight of coke was used for the fusion of 1.131 of mixed ore and flux, and now one part of coal is used to 1.675 of ore and flux. This coal would yield but .38 ( $\frac{3}{8}$ ths) of its weight of coke, and melt therefore but .43 of mixed ore and flux. The causes assigned by M. Lampadius, are therefore probably correct, being necessary in addition to that just examined, to explain the various effects.

#### ON THE CAUSES OF THE EFFICACY OF THE HOT AIR BLAST.

It is plain that if cold materials are introduced within a furnace, they tend to lower its temperature, while their own is raised. If then the fuel and the blast be heated before they act chemically, to a temperature nearly equal to that of the part of the furnace at which the combination takes place, this heated portion will be increased in extent, its temperature will be higher than it would be under other circumstances, and the amount of heat, therefore, available in melting the ore, &c. will be greater. In smelting furnaces the fuel and ore are always thus heated. This is not the case, however, with the blast. In fact it has hitherto been considered an advantage to have the air as cold as possible, that it might contain more oxygen in a given bulk, and experience showed, in conformity with this view of the matter, that blast furnaces worked better in winter than in summer, and better at night than during the day. The expansion of air by heat causing, under a given pressure, less oxygen to be thrown into the furnace, will produce a diminished consumption of fuel, and yield of metal. In wind furnaces, in reverberating furnaces, and generally in all where an ordinary draught is used, an increased temperature in the air diminishes the draught. It can only be increased by raising the temperature of the air in the furnace, by the use of a more freely burning fuel, by additional attention in firing, &c. The same difficulty occurs in the blast furnace, if the power of the blowing machine cannot be increased.

It so happens that at the very time the air is warmest, springs are lowest, and the condensation of steam most difficult, two facts which will explain why the working of furnaces, both as to quantity and quality, is better in winter than in summer. If the weight of air thrown into the furnace had been made the same in summer as in winter, by increasing the power of the blowing machine, and the area of the blast pipes, it is probable that the working would not have been worse, in the former season than in the latter.

An artificial heating of the blast should produce the same effects as that just alluded to, and it is by no means surprising that the efficacy of the hot blast has been doubted. It remains to be seen whence this efficacy results.

M. Dufrenoy\* has, in his explanation of the advantages of the hot air

\* *Annales des Mines*, vol. IV. This Journal, page 419, vol. XV.

blast, shown the difference between the quantities of heat introduced into the furnace with the hot and cold blasts, and in an assumed case has determined this difference to amount to about one-sixteenth of the heat evolved by the combustion of the fuel. Since less air is thrown into the furnace in using the hot blast, there is of course, on that account, less cooling effect to contend against than in the other case.

M. Clement Desormes concludes by calculating from data in an assumed case, that the temperature within the furnace is increased between  $270^{\circ}$  and  $360^{\circ}$  Fah. by the heated air blast; an increase which he considers adequate to explain all the observed effects.

These theories are far from settling entirely, the question in an economical point of view. They suppose indeed, that the consumption of fuel in heating the air may be equal to that saved in the reduction of the ore, which is by no means the case.

I propose therefore to classify the observed effects, and to point out their relative degrees of importance, and their connexion with each other and with established physical principles.

The effect of heating air being to diminish its density, and the consequences of this being decidedly bad when the air is but slightly heated, why should a further increase of temperature, even with a diminished pressure and density, produce so great advantages? The explanation is that the temperature of the air has a most important effect on the intensity of combustion, and there is no doubt a point at which this effect begins, and another beyond which it would hardly be sensible. Observation confirms this explanation. Bars of iron are readily raised to a welding heat in a smith's forge, supplied with hot air, in half the time required by the cold blast, and as the same quantity of coal is consumed per day in both cases, the greater effect in the former can only result from an increased intensity of combustion.\* In the most successful trials the air was heated to  $370^{\circ}$  and the diameter of the blast pipe not being changed, the quantity thrown in was actually diminished, and yet there was an increased consumption of fuel. It is then the temperature of the air, and not its density, which determines the intensity of the fire.

In the furnace, then, the fuel is burned to the greatest advantage; but, further, the heat thus produced is rendered most effective. There can be no doubt that, in order to the regular working of the furnace, the different layers of the charge must descend regularly and horizontally. By the hot air process, the fuel is more completely converted into carbonic acid, than in the old process; more fuel is consumed in a given place, the temperature of which is, therefore, higher than in the former case; and this place of intense heat is more extended. As consequences, a greater mass of ore is reduced in a given time by the same weight of fuel, and more refractory ores can be reduced.

The charges descend more slowly, probably, because it requires more time to consume a large quantity of combustible in a given place, than to burn it through a considerable extent of the furnace. The air being com-

\* Anthracite coal merely requires its temperature to be sufficiently raised to make it keep up the combustion by the heat which it gives out. Iron wire, to burn in oxygen, requires its temperature to be first raised, and may be burned in chlorine if first fired by the combustion of copper wire. Iron filings, finely divided, burn in the air, and in the experiments of Mr. Tyler, a fire was made in a smith's forge, from iron turnings, by raising the temperature with fine turnings. At last the whole burning mass was iron, and a welding heat was produced upon a bar thrust into it. [Trans.]

pletely deprived of its oxygen in the lower part of the furnace, cannot consume any of the combustible higher up. The charges have all moisture, or gaseous matter, completely driven off by the hot gases passing through them, and arrive, duly heated, at the place where the most intense heating effects are produced. This diminished rate of descent is entirely consistent with an increased yield of metal, since the amount of ore in each charge is increased.

From the intense action referred to above, results a greater fluidity in the slag, a diminution in the quantity of flux, the possible use of more refractory ores, or an increased proportion of others in the charges, and the production of gray pig iron, by proportions in the charge in a furnace, which, before, would yield only white, or mottled, castings.

In conclusion, it may be remarked that some changes may probably be made with advantage in the forms of furnaces using the hot air blast. It is difficult to point them out, and their determination will require repeated trials, and with the precise ores and combustibles intended to be used in a particular case. I would suggest, however, especially where forged iron is to be made, enlarging the furnace at and above the boshes, diminishing, at the same time, the height of the whole furnace. This latter change is understood to have already been made with advantage, in certain furnaces using charcoal as a fuel.

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*Effect of Drawing, Rolling, Annealing, &c., of the Metals.*—In a paper on the ductility and malleability of certain metals, and on the variations of density which they undergo by different operations, M. Baudrimont develops the following interesting facts.

At a temperature rather above a cherry red, iron wire remained three months, surrounded by charcoal, without cementation taking place. A white heat, in five minutes, gave the properties of cast-iron to a square bar of malleable iron, of four-tenths of an inch on a side.

Wires of copper, and of alloys of copper and zinc, are increased in diameter, and diminished in density, by annealing. The operation of rolling condenses the metals more than that of wire drawing. The density of iron and copper is greater, if the metals are heated before being passed through the rollers. The reverse is the case with alloys of copper and zinc. The density of the metals is greatest when drawn into very fine wires.

Wires may be increased in length in two ways, by a diminution in the area of their cross section, or by increasing the distances between their particles. When wires are lengthened in the manner last named, they return to their former length by annealing.

Hydrogen has an action on copper and silver, at high temperatures, which permanently separates their particles. On alloys of copper and zinc, and even of silver and copper, it has no such action.

Wires of different metals, which, after passing through the same hole in the wire drawing plate, have different diameters, acquire equal diameters by annealing.

The diameter of a wire increases, very slowly, by time, after passing through the wire drawing plate. Wires which have been bent, and then straightened, re-acquire a curvature.

Wires exposed to a high heat, lose a part of their tenacity. They require to be annealed in wire drawing, not to render them more tenacious, but to allow the particles to resume the positions from which they may again be

displaced. The loss of tenacity is common to copper, iron, platinum, and the alloys of copper and zinc.

Brass wire approaches to iron in strength, while copper is inferior to it. Brass may be used instead of iron, where the latter would oxidate too rapidly.

The iron wires are given at strengths from 79,000 lbs. to the square inch to 127,600 lbs. The brass wires, from 78 to 87,000 lbs. to the square inch. Copper, from 38 to 44,000 lbs. The diameters of the least and greatest wires were, iron, .014 inch, and .205 inch; brass, .070 and .267 inch; copper, .019 and .285 inch.

The finer wires bear greater weights, in proportion to their areas, than the coarser ones, because the particles of the former are compacted through the whole cross section, while those of the latter, for a certain depth only, are thus forced together.—*Ann. de Chim. et de Phys.*

*A short Remark or two on what is commonly called Dry Rot, by Charles Waterton, Esq.*—Dry rot is a misnomer. This disease in timber ought to be designated a decomposition of wood by its own internal juices, which have become vitiated for want of a free circulation of air.

If you rear a piece of timber, newly cut down, in an upright position in the open air, it will last for ages. Put another piece of the same tree into a ship, or into a house, where there is no access to the fresh air, and ere long it will be decomposed.

But should you have painted the piece of wood which you placed in an upright position, it will not last long; because, the paint having stopped up its pores, the incarcerated juices have become vitiated, and have caused the wood to rot. Nine times in ten, wood is painted too soon. The upright unpainted posts, in the houses of our ancestors, though exposed to the heats of summer, and the blasts of winter, have lasted for centuries; because the pores of the wood were not closed by any external application of tar or paint; and thus the juices had an opportunity of drying up gradually.

In 1827, on making some alterations in a passage, I put down and painted a new plinth, made of the best, and apparently, well-seasoned foreign deal. The stone wall was faced with wood and laths; and the plaster was so well worked to the plinth, that it might be said to have been air-tight. In about four months, a yellow fungus was perceived to ooze out between the bottom of the plinth and the flags; and on taking up the plinth, both it and the laths, and the ends of the upright pieces of wood to which the laths had been nailed, were found in as complete a state of decomposition as though they had been buried in a hot-bed. Part of these materials exhibited the appearance of what is usually called dry rot; and part was still moist, with fungus on it, sending forth a very disagreeable odour. A new plinth was immediately put down; and holes,  $1\frac{1}{2}$  inches in diameter, at every yard, were bored through it. This admitted a free circulation of air; and to this day the wood is as sound and good as the day on which it was first put down. The same year, I reared up, in the end of a neglected and notoriously damp barn, a lot of newly felled larch poles; and I placed another lot of larch poles against the wall on the outside of the same barn. These are now good and well seasoned: those within became tainted the first year, with what is called dry rot, and were used for fire-wood.

If, then, you admit a free circulation of air to the timber which is used in a house (no difficult matter) and abstain from painting that timber till it

be perfectly seasoned, you will never suffer from what is called dry rot. And if the naval architect, by means of air-holes in the gunwale of a vessel (which might be closed in bad weather), could admit a free circulation of air to the timbers; and if he could, also, abstain from painting, or doing with turpentine, &c., the outer parts of the vessel, till the wood had become sufficiently seasoned, he would not have to complain of dry rot. I am of opinion, that if a vessel were to make three or four voyages before it is painted, or done with turpentine, &c., its outer wood would suffer much less from the influence of the weather than it usually suffers from its own internal juices, which cannot get vent, on account of artificial applications to the pores. But still the timber would be subject to the depredation of the insect. To prevent this effectually, Mr. Kyan's process must absolutely be adopted; and it must also be adopted to secure wood from what is called dry rot, in places where a free circulation of air cannot be introduced. I consider Mr. Kyan's process perfectly unexceptionable. The long arrows which the Indians use in Guiana are very subject to be eaten by the worm. In 1812, I applied the solution of corrosive sublimate to a large quantity of these arrows. At this hour they are perfectly sound, and show no appearance that the worm has ever tried to feed upon them.

I have penned down these transient remarks by way of preface to others, which I may possibly write, at some future time, on decay in living trees.

*Loudon's Architect. Mag.*

*New Spirit Lamp.*—A new and convenient spirit lamp, with an eolipyle having a vertical jet, is described by M. Pelletan, as the invention of M. Breuzin, of Paris. The entire apparatus is placed on a neat tripod stand, arranged for holding the vessel to be heated. The wick of the lamp is hollow, and is raised or depressed by a screw and rack. Above the lamp is an eolipyle of a cylindrical shape, through the middle of which the flame of the lamp passes. The vessel to be heated being placed above the eolipyle, retains the full effect of the flame of the lamp. The jet pipe from the eolipyle passes downwards, and by a bend is introduced into the axis of the cylindrical wick of the lamp. The alcohol flame is thus entirely vertical, and the apparatus is much more convenient than the common eolipyle where the jet is horizontal. By using vessels properly arranged to economise heat, a pint of water may be boiled in five minutes, and at a cost of less than half a cent (at Paris.) In a common coffee biggin, the same quantity of water may be boiled for about a cent. (*Jour. Connaiss. Us. et Prat.*)

*Application of Tannate of Gelatin to taking Casts from Medals, &c.*—This substance is obtained by adding a decoction of gall nuts, sumac, oak bark, or other substance containing tannin, to a solution of glue or isinglass, in water. It is fibrous and nearly insoluble. When exposed to the air in thin layers, it hardens. When moist, it is elastic.

The substance which was found to give the best mixture for casts, was finely pulverized slate. Silica, emery, &c. give pastes which harden, and may be used for razor straps.

In making casts of the mixture of tannate of gelatin and pulverized slate, it must be left for a certain time in the mould, in order to preserve the impression. If, however, it is allowed to remain there too long, it adheres strongly. The only difficulty in the application is to ascertain the precise time required for due hardening.

This substance may replace bronze in ornaments, papier maché, card work, &c. *Ibid.*

*Analysis of two varieties of Bronze.*—These specimens were analyzed by M. Berthier. The first was intended for the manufacture of cannon, but proved of bad quality; its composition was ascertained to avoid the same proportions in other mixtures. It consisted in 100 parts, of copper 83.8, tin 15.7, lead 0.5.

The bronze used at Paris for the striking parts of clocks, was found to be composed in 100 parts, of 71 to 72 of copper, 26.56 to 27 of tin, 1.44 to 2 of iron. *Ann. des Mines*, vol. VII.

*Sheathing of Ships with Bronze.*—The sheathing of this metal has been found by experiment, to lose but half the weight, in a given time, which copper would have lost. The composition used for making sheet bronze is 91 of copper and 9 of tin. *Ibid.*

*Durability of Acacia Wood.*—It was found that in the mining galleries at Carmaux, (France) the oak timber used to support the sides and top of the galleries, decayed very rapidly, being affected by the dry rot. A comparative experiment was made with acacia wood, from which it resulted that the latter wood is much more durable than the former, when exposed in such situations. Oak timber decayed in three months, while the acacia was unacted upon, except at the sap-wood surface, in four years.

The lateral strength of this wood is about equal to that of Norway pine. *Ann. des Mines*, vol. VII.

## Progress of Physical Science.

*Experimental Researches in Electricity. Eighth Series.* By MICHAEL FARADAY, &c. &c. *Phil. Trans., Lond.*, 1835.

(Abstract concluded from page 285.)

13. The actions of dilute sulphuric acid on the zinc plates of a galvanic circle, may be distinguished into two parts. one which acts directly on the zinc, evolving hydrogen on its surface, the other which “producing an arrangement of the chemical forces throughout the electrolyte present (in this case water) tends to take oxygen from it, but cannot do so, unless the electric current consequent thereon can have free passage, and the hydrogen be delivered elsewhere than against the zinc. The electric current depends altogether upon the second of these.”

(a.) In the ordinary use of zinc in the galvanic battery, there is a waste of power amounting to all the chemical action which takes place when the (electrodes) poles are not united. This is placed in a strong point of view by recollecting that the proper oxidation of three and a half ounces of zinc should decompose nearly one ounce of water, and evolve about 2400 cubic inches of hydrogen gas.

(b.) When impure (common) zinc is used, this loss of power is greater than when pure zinc is employed. The metallic impurities forming small galvanic circles on the zinc, tending to convey the electricity back to the zinc.

(c.) Amalgamated zinc has no such defects. It decomposes the water of the acid solution only when the circuit is completed. It ceases to act as soon as the poles are separated, and hence economy of both metal and acid. The mercury probably acts by bringing the whole surface of the zinc into a uniform condition, so that one part has no more tendency to evolve electricity than another, and hence no discharges take place from one point of the metal to another. A battery formed of such plates has the powerful

condition incident to rest renewed, by merely separating the poles. It soon arrives at a permanent condition, any oxide formed at the surface of the zinc plates, being removed as soon as produced.

14. The voltaic battery may, possibly, in its improved forms, become applicable to manufacturing purposes, for, by it, an equivalent of a rare substance may be obtained, at the expense of several equivalents of common ones, such as zinc, and sulphuric acid.

15. If a zinc and platinum plate, plunged into dilute acid, be connected, by wires, with two platinum plates, which are also immersed in dilute acid, the electricity evolved by the action of the zinc in decomposing water, cannot pass, unless the water in the second cup be also decomposed. A similar arrangement will be formed, if a cell, to contain dilute acid, have, on one side of it, a zinc plate; on the opposite, a platinum plate, connected, by a platinum wire, with the zinc; and, midway between these two plates, a second platinum plate; the water between the zinc and middle platinum plate cannot be decomposed, unless the electricity evolved can also decompose the water between the two platinum plates. Mr. Faraday calls this second platinum plate, against the sides of which, the hydrogen and oxygen are evolved, the interposed plate. From the action of interposed plates, he draws new proofs of the identity of electrical forces with chemical affinity. The facts, and their explanations, are as follows.

(a.) When dilute sulphuric acid was used in the cell, with one pair of plates, before alluded to, one interposed plate stopped the current. One interposed plate effectually stopped the current of two galvanic pairs, but allowed that from three to pass.

The distance between the interposed plates, and their size, did not vary the result. When nitric acid was added to the liquid between the interposed plates, the current from one pair could pass, and when also added in the cell, between the galvanic plates, the current passed freely. Muriatic acid produced a less effect.

The current does not pass in the first mentioned case, because the water in the interposed cell must first be decomposed, and this it cannot be, unless the zinc have twice the affinity for oxygen that hydrogen has, since these elements are to be separated from each other, both in the cell between the galvanic plates, and in the interposed cell. This explains why the current from two pairs of plates may pass feebly, while that from three has free passage. The affinity of hydrogen and oxygen for each other being the resisting force, and not the want of conducting power in the interposed fluid, the thickness of the interposed stratum is, within limits, not an element in the effect. When nitric acid is added to the liquid in the interposed cell, its oxygen combines with the hydrogen of the water, when decomposed, and hence an affinity is introduced to aid decomposition.

(b.) When two interposed platinum plates were used, they allowed a feeble current from five plates to pass, and none from four. When four interposed plates were used, a very feeble current passed; by the removal of one of them, a somewhat stronger current passed; and with only one plate, the current was little obstructed. The effect of successive interpositions appears, as it ought to be, very different.

(c.) In all these experiments, a very feeble current, at first was observed to pass, water conducting such a current as the metals do, but in an imperfect degree.

(d.) When zinc was used to form any number of interposed plates, no apparent retardation of the current resulted. The zinc, of itself, being able

to decompose water. Amalgamated zinc plates, two in number, retarded the current, though a single one appeared not materially to affect it.

16. The strength of action of a galvanic battery declines, not only from the products of its own action, but, in certain cases, from the curious condition of metals, by which there is a tendency to produce a reverse current.

(a.) The effect of the combination of the acid used in the cells of a battery, with the oxide of zinc, explains the rapid declension of galvanic action, and the reason why stopping the current, or removing the plates from the acid, causes a recovery of energy.

(b.) The second cause of declension is illustrated by using a cell similar to that described for investigating the effect of one interposed plate. A platinum wire, joining the exterior and interior platinum plates, was found by the galvanometer to have a powerful momentary current passing through it, at the instant of joining the plates, and in a reverse direction to that produced by the galvanic circle.

(c.) This peculiarity is traced as the cause why an interposed plate of copper at first allowed the current from one pair of plates to pass, and afterwards appeared to stop it. By turning the copper plate round, so as to change the directions of the exposed surfaces, the effects were reversed.

(d.) This same condition explains why a battery of platinum and copper plates, with dilute sulphuric acid, is competent to act only for a short time.

*On Springs, Artesian Wells and Spouting Fountains, by M. Arago.* By artesian wells are meant those of which the waters rise to or above the surface, on boring to a greater or less depth. They were known to the ancients, exist in the deserts of Sahara, as well as in the fertile plains of Southern France. They are called artesian from the Latin name of the county of Artois, in France.

M. Arago examines the following questions, and derives the conclusions which are stated.

1. Whence is the water of these wells derived? Not by filtration of sea water. Not by the evaporation and subsequent condensation of subterranean waters, but by the filtration of rain water until it reaches strata which prevent further progress. A recent gauging of the Seine has shown that but one-third of the water which it receives from rain, &c. reaches the sea, leaving two-thirds to be accounted for by evaporation, by that consumed in the support of vegetable and animal life, and by filtration.

2. How does this filtered water exist and circulate in the various formations which compose the earth's crust? In primary rocks springs are found to be small, and the issues are near the sources of the water. The stratified rocks of the secondary formations afford excellent floors for the passage of subterranean waters. They sometimes form basins, in some of which water collects. In the secondary strata springs are more rare than in the tertiary, but give more water when struck.

3. What power raises the water of artesian wells to or above the surface? Hydrostatic pressure. The water-bearing strata form reversed syphon-shaped interstices, and the pressure of the water in one branch raises the water in the other. In Artois this pressure must be transmitted sometimes more than one hundred miles.

M. Arago develops the following among other interesting facts.

The temperature of the water in these wells is uniformly higher than that of the surface at which they escape.

One of these wells in France, made in excavating for coal, is 1000 feet deep. Chiswick spring is supplied by a well bored to the depth of 582

We append to the foregoing report of the Committee on Explosions, a document which appears in the authorized copy of the report as a preface, and which contains an account of the transactions of the Committee.

COM. PUB.

## PREFACE.

The Committee, whose report of experiments, made by the request of the Secretary of the Treasury of the United States, is presented in the following pages, was appointed on the 10th of June, 1830, for the purposes expressed in the annexed resolution of the Board of Managers of the Franklin Institute, of the State of Pennsylvania, for the promotion of the Mechanic Arts.

*“Resolved, That a committee of seventeen members be appointed, to examine into the causes of the explosions of the boilers used on board of steam-boats, and to devise the most effectual means of preventing the accidents, or of diminishing the extent of their injurious effects.”\**

The Committee consisted of the following named members of the Institute.

Alex. D. Bache, *Chairman.*

Robert Hare, M. D.

S. V. Merrick,

W. H. Keating,

Isaiah Lukens,

James J. Rush,

James Ronaldson,

Frederick Graff,

R. M. Patterson, M. D.

J. K. Mitchell, M. D.

Benjamin Reeves,

George Fox,

Thomas P. Jones, M. D.

W. R. Johnson,

M. W. Baldwin,

James P. Espy,

George Merrick.

Immediately after their appointment, the Committee addressed a circular letter to persons, whom they supposed would be able to give information, in regard to the explosions of steam-boilers which had occurred in our country, or abroad, and of which no accounts had been previously published. They took, also, other means to inform themselves on the subject referred to them.

The information derived from replies to the circular has already been made public.†

While the Committee were engaged in the inquiries necessary to enable them to report to the Managers of the Franklin Institute, a letter was received by that body from the Secretary of the Treasury of the United States, informing them that funds had been placed, by the House of Representatives, at the disposal of the department, for inquiries in regard to the explosions of steam-boilers, and inviting experiments on the subject, by the Institute, at the expense of the Treasury Department.

A series of questions, connected with the probable causes of explosion, or with theories which have been offered in relation to them, and with the safety of the steam engine, was submitted to the Secretary of the Treasury, with a plan of experiment based upon the queries, and an estimate of the cost of the experiments. This plan was approved, and authority given to add to the original subjects proposed for investigation, any others which might suggest themselves in the course of the experiments; the amount to be expended being, however, limited.

\* This resolution was moved by W. H. Keating, Esq., who subsequently declined the chair of the Committee, and Prof. A. D. Bache was chosen chairman.

† Journal Franklin Institute, vols. viii., ix., and x.

In order to carry on the experiments, the following sub-committees were appointed.

1. On the experiments,\* excepting those relating to the strength of iron and copper.

Messrs. A. D. Bache,	M. W. Baldwin,
Benjamin Reeves,	S. V. Merrick,
W. H. Keating,	Isaiah Lukens.

2. On the strength of iron and copper used for steam-boilers.†

Messrs. W. R. Johnson,
A. D. Bache,
Benjamin Reeves.

The first of these sub-committees presented the report of their experimental investigations, which, having been examined by the Committee, was finally adopted on the 23d of December, 1835, and ordered to be submitted, through the Managers of the Institute, to the Secretary of the Treasury.

The labours of the second sub-committee, as well as a report on the subjects in relation to which the Committee was appointed, yet remain to be presented.

It was deemed proper to delay such a report, until all the light which the experiments could afford, had been shed upon the important and intricate subject referred to the Committee.

On behalf and by direction of the Committee, &c.

ALEX. DALLAS BACHE, *Chairman.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Account of the Explosion of the Boiler of the Steamboat Wm. Gibbons.* By  
THOMAS EW BANK, of New York.†

This explosion occurred on Thursday morning, January 21st, as the boat was entering this harbour, on her return from Charleston, (S. C.) By this melancholy disaster, six lives have been lost.

The Wm. Gibbons has but one boiler, made of wrought iron, and similar in its construction to those of the "Ohio," and "New England," but having a greater number of horizontal flues. These terminate, as in the boilers of those boats, in a large vertical flue, which passes through the roof of the boiler. It was this flue which was collapsed. The following memoranda were made by me on different visits to the boat.

*January 24.* I visited the Wm. Gibbons this day. The chimney proper, or smoke pipe, (represented by the dotted lines, *a, a*, in the annexed sketch, Plate XVII., Fig. 1,) had been removed. Upon looking down, the collapse was quite obvious. The flue was pressed together, so as to be closed almost entirely at the part where the rent had taken place. A section of

\* This sub-committee had the subjects referred to them on the 1st of November, 1830.

† Appointed January 4th, 1831.

‡ This interesting account was addressed to the Committee on Explosions, in consequence of a request made to Mr. Ewbank by a member of that Committee. We feel persuaded that if intelligent men at the different places near which explosions occur, would take pains to ascertain the nature of the effects, and make public the results of their examinations, the cause of humanity would be essentially served. It will be seen that Mr. Allaire, the maker of the boiler of the Wm. Gibbons, has set a most praiseworthy example, by affording every facility for examining the effects of the explosion.

that part is represented at F, Fig. 2, exhibiting a three cusped figure, instead of that of a circle, its original form. As the flue was still enclosed in the case B, the precise situation of the rent with respect to the surface of the water in the boiler, could not then be accurately ascertained, without entering the boiler. The collapsed flue is made of quarter inch iron, and is three feet in diameter. A space of seven inches is left between it and B. The steam pipe, S, is connected to the latter at its upper end, which is eight feet above the roof of the boiler.

*January 26.* This day B was removed, leaving the ruptured and vertical flue, C in the sketch, fully exposed to view. The rent, R, was four inches above the roof of the boiler. It was in one of the horizontal seams, and confined almost wholly to it; it extended nearly three feet, or about one-third of the circumference. The line of separation was through the centre of the rivet holes, nearly the whole extent, a strip of metal thus separated being left in its place, in the lower portion of the flue. The iron is cracked in some places, where the flexure has been greatest, as at O.

Through the politeness of James P. Allaire, Esq., the builder of the engine and boiler, and also one of the owners of the boat, I have obtained a portion of the ruptured flue, which is sent with this communication. It is from one end of the rent. The thickness of the metal at the part ruptured is not sensibly diminished, as will be perceived by the specimen sent. The question of the deterioration of the metal by heat, may perhaps be determined by it also.

The original cause of this explosion is conceived to be identical with that of the Ohio,\* and is to be found in the "construction of the boiler," the arrangement of the flues in it being such that the principal one, (that which collapsed,) could not be protected by the water. Its exposure to high degrees of temperature, under these circumstances, must necessarily diminish its strength very materially. The increase of its temperature is also accompanied with an increased elasticity of the steam; hence its power of resisting the pressure around it diminishes as that power is augmented.

In addition to the remarks made on these flues in the case of the Ohio, it may be further observed, that, from their greater dimensions compared with the horizontal ones, their strength necessarily bears no comparison with that of the latter, even if covered, like them, with water. How much more liable to destruction, then, are they, wholly unprotected by it? The horizontal flues of the Wm. Gibbons do not exceed twelve inches in diameter; the ruptured flue, as before observed, is thirty-six inches.

If steam chimnies are deemed indispensable, would it not be safer to convey each horizontal flue separately through the roof of the boiler, than to combine them all in the large one in question?

The surest remedy, however, is to make all interior flues terminate outside of the boiler, *below* the water line. Neither this explosion, nor that of the Ohio, could have occurred, if such had been the arrangement in their respective boilers.

The immediate cause of the explosion is attributed, and no doubt justly, to the imprudence of the second engineer, and two of the firemen,† in wantonly urging the fire with quantities of wood, (anthracite coal being the principal fuel used,) and thus unnecessarily, at that time, increasing the force of the steam, and the heat of the vertical flue, against the positive and

\* See this Journal, vol. x., p. 226, Ewbank on the Explosion of the Steamboat Ohio. The effects on the boiler, in that case and this, are strikingly similar. COM. PUB.

† They were all killed.

repeated directions of the chief engineer, who was very unwell at the time. It appears that one or more of them ridiculed the apprehensions of that officer, while in this act of disobeying his orders. His reasons for giving such directions are not left to conjecture, when we learn that, off Cape Hatteras, he had discovered that the vertical flue was pressed inwards, in one place, although but slightly. This is the fact referred to by one of the passengers, (Mr. Newmark,) in the statement which follows. The repairs done to the boiler, near Cape Hatteras, were in consequence of a leak near one of the fire doors.

The engine and boiler were considered in good repair; there was no design to repair either previous to the next trip, as has been stated in some of the papers. The only alterations contemplated were in the paddles, which they are now undergoing.

The following statement of a number of the passengers who were on board of the William Gibbons, was published just subsequent to the explosion.

*To the Public.*

The undersigned, passengers on board the steam packet Wm. Gibbons, on the occasion of her late disastrous trip from Charleston to this port, convinced that no adequate account has yet been given to the public of the circumstances connected with the explosion, by which six unfortunate individuals were hurried away in all the vigour of life, feel it to be their duty to submit to the community a concise statement of certain facts within their personal knowledge. Events so calamitous, however great the individual anguish of which they are the occasion, may, nevertheless, be the source of some public good; but this good can spring only from a development of all their attendant circumstances, to such an extent that they may constitute a warning and a lesson for the future.

The Gibbons left Charleston on the morning of Sunday, the 17th of January, at 10 o'clock. On Monday, about sunset, she passed Cape Hatteras. Not long afterward, the engine was stopped, the fires extinguished, and the water discharged from the boiler. The whole night was consumed in repairs, with the precise nature of which we were, at the time, unacquainted. The inquiries of the passengers failed to elicit any satisfactory information; there seemed, indeed, to exist a studied determination, on the part of those in authority on board, to avoid making any disclosures.

After this time we carried very low steam, the gauge rod not standing generally higher than seven, eight, or nine inches. Before reaching Cape Hatteras, it had stood usually at fifteen, sixteen, or eighteen. Being in plain sight, it was frequently noticed, for many of the passengers were suspicious of our danger, and mentioned their apprehensions repeatedly.

On Thursday morning, it was remarked that we were again carrying heavy steam, a circumstance which had not been before observed since the occurrence at Cape Hatteras. A gentleman who was standing near the steam chimney, for the purpose of warming himself, called the attention of another to the fact that the rod stood at fifteen inches. This was mentioned to several, who observed that our speed indicated high pressure. These gentlemen believe that not more than ten or fifteen minutes had elapsed after this observation, before the explosion took place. In order, however, to be perfectly safe, they are willing to testify that the time was not greater than half an hour; our speed, meanwhile, by no means indicating a diminished power. Let this be compared with the statement which has been given to the public, that, at the moment of the accident, the rod stood at

feet. A well in the department of Pas de Calais throws its water to the height of seven feet above the ground, and is 461 feet deep.

*Unpleasant effects upon the system at great heights.*—The vertigo and other disagreeable sensations experienced at great elevations are due, according to M. Boussingault, the intrepid traveller who has recently ascended Chimborazo, (1831) to the exertion of the lungs in speaking. At the height of three miles they found the air nearly saturated with moisture, the thermometer being at  $\frac{3}{4}$  of a degree of Fahrenheit's scale, above the freezing point of water. The cracking of the skin is not due then to the dryness of the air. It is to be explained by the excessive quantity of light reflected from the snow and ice, and to be guarded against by a veil of gauze or crape, of suitable colour.

M. Boussingault and his companions attained the height of three miles and three quarters above the level of the sea.—*Ann. de Chim. et de Phys.*

*Comets shine by reflected light.*—M. Arago considers himself entitled to infer, positively, from observations made during the recent return of Halley's comet, that this body, like the planets, derives its light from the sun.—*Jameson's Journal.*

*Aurora Borealis, of October 18th, 1835.*—It will be remembered that a very splendid display of the aurora was seen in the United States, on this evening, and a less brilliant and extensive one on the 19th. The aurora was seen throughout Great Britain on the same evening. At Paris, where the weather was cloudy, the magnetic needle was considerably disturbed on the 17th, 18th and 19th of November. At Nismes, in France, there was a brilliant aurora seen on the 18th.

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## Mechanics' Register.

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*Water-Proof Fabric.*—The following composition for rendering cloth, paper, &c. water-proof, is the subject of a recent patent in England. Dissolve half an ounce of isinglass in a pound of soft water. Dissolve one ounce of alum in two pounds of water. Also one quarter of an ounce of soap in one pound of water. After straining each solution, if necessary, to separate impurities, mix them, and simmer over a fire for a short time. The liquid is to be used hot.

This liquid is considered applicable to cloths; for lighter fabrics the proportions and ingredients are varied as follows. One quarter of an ounce of isinglass to a pound of water. Three ounces of alum in three pounds of water. Half an ounce of soap in an ounce and a half of oil of turpentine, and mix it with a pound and a half of water. One ounce of fine glue in a pound of rain water. One ounce of gum arabic into half a pound of water. The alum, glue and gum, after being separately dissolved, are to be mixed and some time afterwards the soap is to be added. The ingredients to be mixed hot.—*Lond. Rep. Pat. Invent.*

*Magnetic Locomotive Engine.*—A very successful trial of a locomotive impelled by magnetic force, is said to have been made by M. Lemaire, of Brussels.

*Prize Chronometers.*—The first prize of £200, for chronometers, deposited, and under trial at the Greenwich Observatory, has not been awarded during the past year.—*Arcana of Sc.* 1835.

*Birmingham Organ.*—This very large and powerful instrument has been

put up in the town hall of Birmingham. The space occupied by it is 35 feet in width, 15 feet in depth, and 45 feet in height. There are four rows of keys, and sixty stops. The largest pipe has a capacity of 217 cubic feet. The town hall will seat between three and four thousand persons.—*Arcana of Sc.* 1835.

*Preservation of Plants in Brine.*—Strong brine is stated by a correspondent of the Linnæan Society, to preserve plants, without affecting their colours.

*Vapour Cave at Pyrmont.*—A cavern has been excavated near the celebrated springs of Pyrmont, in imitation of the Grotto del Cane, near Naples. The air at the bottom of the cavern contains in one hundred parts, 48 of carbonic acid, and 52 of atmospheric air, by measure.—*Arcana Sc.* 1835.

*Cultivation of Beet in France.*—Two acres and a half of good land produces 47 cwt. 36 lbs. of beet root. From 100 lbs. of which seven or eight of saccharine matter is obtained, a part of which is molasses, the rest sugar. The pulp remaining, after extracting the sugar, affords a nutritious food for cattle.—*Arcana of Sc.* 1835.

*Insects destroyed by Chamomile.*—This herb, either in decoction or powdered, will destroy insects upon plants; even the growing herb has this effect.

*New Journal of Popular Science.*—The Society for the illustration and encouragement of Practical Science, well known for their exhibition room, the Adelaide Gallery, London, have undertaken a "Magazine of Popular Science, or Journal of the Useful Arts," of which the first number appeared on the first of February last.

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*List of American Patents which issued in February, 1836.*

February

41. <i>Peeling apples.</i> —John W. Hatcher, Bedford county, Virginia,	3
42. <i>Cooking stove.</i> —R. G. Cochran, Francistown, N. H.	3
43. <i>Ropes and cordage.</i> —William Fanning, New York,	3
44. <i>Cooking stove.</i> —Daniel Williams, Scaghticoke, N. Y.	3
45. <i>Cultivator.</i> —James M. Garnett, Loretto, Virginia,	3
46. <i>Shelling corn.</i> —Isaac A. Hedges, Elmira, N. Y.	3
47. <i>Oven.</i> —Samuel Pollard, Orono, Maine,	3
48. <i>Saw mill.</i> —George W. Black, Montgomery county, Tennessee,	3
49. <i>Straw cutter.</i> —Isaac O. Wright, Elbridge, N. Y.	3
50. <i>Mowing, thrashing, &amp;c. machine.</i> —E. Briggs and G. G. Carpenter, Fort Lovington, N. Y.	5
51. <i>Saddle tree.</i> —Andrew R. McBride, Williamson county, Tennessee,	5
52. <i>Horse rake.</i> —Joseph W. Webb, Mount Morris, N. Y.	5
53. <i>Smut and hulling machine.</i> —Samuel Richardson, Elmira, N. Y.	5
54. <i>Tobacco press.</i> —A. M. McLean, Russelville, Kentucky,	5
55. <i>Horse power.</i> —Dudley Marvin, New York,	5
56. <i>Churn.</i> —Hezekiah Roberts, Seneca Falls, N. Y.	5
57. <i>Bark, &amp;c. for tanning.</i> —Daniel Williams, Boston, Mass.	5
58. <i>Cotton Gin.</i> —W. and J. McCreight, Winsborough, S. C.	5
59. <i>Grist mill.</i> —W. and J. McCreight, Winsborough, S. C.	5
60. <i>Locomotive engines.</i> —H. R. Campbell, N. L. Philadelphia,	5
61. <i>Bee hive.</i> —J. M. Hubbard, Canterbury, N. H.	5
62. <i>Patterns, &amp;c. for casting.</i> —Lewis H. Maus, Danville, Pennsylvania,	5
63. <i>Thrashing machine.</i> —Lewis H. Maus, Danville, Pennsylvania,	5
64. <i>Saw mill saw.</i> —B. K. Barber, Johnsbury, N. Y.	5
65. <i>Blood, equalizing the</i> —S. R. Terrell, Burton, Miss.	5
66. <i>Mortice locks.</i> —P. and E. W. Blake, New Haven, Connecticut,	5
67. <i>Flour cooler.</i> —Josiah Pope, Windham, Maine,	5
68. <i>Fermenting and distilling.</i> —Joseph Stowell, Manchester, N. H.	5

69. <i>Cramping boot legs.</i> —William Gerrish, Poland, Maine,	10
70. <i>Gun locks.</i> —Samuel Morrison, Milton, Pennsylvania,	10
71. <i>Twain water wheel.</i> —William L. Elgar, Winchester, N. H.	10
72. <i>Planing machine.</i> —Melzer Tuells, Milo, N. Y.	10
73. <i>Shelling corn.</i> —Henry G. Neale, Poultney, Vermont,	10
74. <i>Straw cutter.</i> —C. D. Skinner and D. Read, Haddam, Connecticut,	10
75. <i>Churn.</i> —Lyman Whittier, Vienna, Maine,	10
76. <i>Straw cutter.</i> —Joseph Everod, Geneva, N. Y.	10
77. <i>Thrashing machine.</i> —Thomas Beede, Sandwich, N. H.	10
78. <i>Grate and cooking stove.</i> —John J. Giraud, Baltimore, Maryland,	10
79. <i>Molasses faucet.</i> —Charles W. Pickham, New Haven, Connecticut,	10
80. <i>Spindle and flyer.</i> —Willard T. Eddy, Ithaca, N. Y.	10
81. <i>Slide valve.</i> —A. McCausland, jr. Philadelphia,	10
82. <i>Crane.</i> —Elias Marsh, Oswego, N. Y.	12
83. <i>Piano forte.</i> —John Pettrick, New York,	12
84. <i>Boats.</i> —Edward Fitzpatrick, Mount Morris, N. Y.	12
85. <i>Churn.</i> —John E. Thomas, Winchester, Ohio,	12
86. <i>Horse power.</i> —Joseph Mustin, Franklin county, Vermont,	12
87. <i>Feathers, cleaning, &amp;c.</i> —Daniel K. Hall, New York,	12
88. <i>Door fastenings for cars.</i> —John K. Smith, Port Clinton, Pennsylvania,	12
89. <i>Feathers, dressing.</i> —Samuel Keplinger, Baltimore, Maryland,	12
90. <i>Washing machine.</i> —Luther Davis, Norwich, Connecticut,	12
91. <i>Drying cotton, &amp;c.</i> —John Philbrick, Cold Springs, Miss.	12
92. <i>Blow-pipe for furnaces.</i> —John Barker, Baltimore, Maryland,	12
93. <i>Sliding grate.</i> —John C. Howard, Hampton, Connecticut,	13
94. <i>Shelling corn.</i> —Ira Smith, Downingtown, Pennsylvania,	13
95. <i>Screws, making.</i> —William Keane, Monroe, N. Y.	13
96. <i>Fanning machine.</i> —D. Flanders and C. Rathburn, Fort Covington, N. Y.	13
97. <i>Sausage meat cutting.</i> —Ambrose Henkel, New Market, Virginia,	13
98. <i>Hydraulic dock.</i> —Zebedee King, New York,	13
99. <i>Belt saw.</i> —William Carey, Poughkeepsie, N. Y.	17
100. <i>Cannon for chain shot.</i> —Edward Gordon, Hingham, Mass.	17
101. <i>Hulling clover seed.</i> —J. B. and W. F. Pogue, Lexington, Virginia,	17
102. <i>Bolt for mail bags, &amp;c.</i> —Ira Atkins, Hanover, N. H.	17
103. <i>Mortice latch.</i> —William Coover, Erie, Pennsylvania,	17
104. <i>Spark catcher.</i> —Abraham McDonough, Philadelphia,	17
105. <i>Puppet valves, raising, &amp;c.</i> —W. Duff and T. Murphy, Baltimore, Maryland,	17
106. <i>Tire for wheels.</i> —James H. Rogers, Mount Morris, N. Y.	17
107. <i>Rice starch.</i> —W. and T. Liversidge, Dorchester, Mass.	17
108. <i>Rotary steam engine.</i> —Aaron Clark, Bangor, Maine,	17
109. <i>Truss for hernia.</i> —William Adair, Pleasant Hill, Kentucky,	17
110. <i>Paper making machine.</i> —Charles Forbes, E. Hartford, Connecticut,	20
111. <i>Glasses for spectacles.</i> —Isaac Schnaitman, N. L. Philadelphia,	20
112. <i>Sawing staves, &amp;c.</i> —A. Band and S. Heywood, Lunenburg, Mass.	20
113. <i>Salt, supplying.</i> —Peter Cooper, New York.*	20
114. <i>Pumps, suction, &amp;c.</i> —Thomas C. Barton, Washington, N. J.	20
115. <i>Flyers for spinning.</i> —Samuel Ladd, Waltham, Mass.	20
116. <i>Saw mill, cross cutting.</i> —Rufus Riker, Dexter, Maine,	20
117. <i>Curing sores.</i> —Reuben Rood, Centre Lisle, Brown county, N. Y.	20
118. <i>Time-pieces.</i> —William Pardee, Poughkeepsie, N. Y.	20
119. <i>Still.</i> —John Wright, New York,	20
120. <i>Thrashing machine.</i> —James Cooper, Greene county, Ohio,	20
121. <i>Winnowing machine.</i> —David Wilson, Johnston, Vermont,	20
122. <i>Injecting syringe.</i> —Joseph Ralph, New York,	25
123. <i>Truss for hernia.</i> —Francis H. Newman, Huntsville, Alabama,	25
124. <i>Lathe for gun stocks, &amp;c.</i> —Abner Town, Woodbury, Vermont,	25
125. <i>Sawing, &amp;c. by lever power.</i> —Jeremiah Walker, Phillips, Maine,	25
126. <i>Cooking stove.</i> —B. and A. Titus, Marshal, N. Y.	25
127. <i>Pump, vibrating.</i> —Sampson Davis, Derby, Vermont,	25
128. <i>Spark catcher.</i> —Francis Milo, New York,	25
129. <i>Smut machine.</i> —Abraham Mudge, Canajoharie, N. Y.	25
130. <i>Saw mill.</i> —David Washington, Peru, Mass.	25

\*Suspended, but registered by mistake.



**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**  
DEVOTED TO  
**Mechanical and Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

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JUNE, 1836.

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**Practical and Theoretical Mechanics.**

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Remarks on Suggestions, by Mr. Perkins, in regard to the Explosions of Steam Boilers. By a CORRESPONDENT.*

There are few subjects of practical science in regard to which the public at large have so deep a stake, as in the determination of the causes of the explosion of steam boilers. And I might add, that there are very few subjects, in relation to which the public require, as yet, more enlightening. Hardly a month passes without some *new boiler* being produced, to be perfectly free from the danger of explosion, and, up to this time, each project has proved an illusion. While the public are thus alternately excited and depressed, practical men neglect even a trial of the various means proposed to render existing boilers more safe, and, without exertion, look on, seeming to consider all devices as alike to be condemned. This state of things is, no doubt, in great part, produced by a want of information in regard to the causes of explosion.

One of the first attempts, on a scale of any magnitude, to remove the existing ignorance on this subject, by experiments, originated with the Franklin Institute; and their committee on the explosions of steam boilers have obviously devoted much time and attention to the researches, which

they were enabled by the government to make,\* on the dangers to which steam boilers are supposed to be liable.

We have a most interesting fruit from the experiments of this committee, in their immediate application to test a theory of explosions recently advanced by our countryman, Perkins, whose name has been so celebrated in this branch of practical science. The theory to which I refer is an extension and modification of the one formerly advanced by him.

This new theory, or rather the causes which he assigns for the explosions of boilers, and those which he rejects as not producing such an effect, will be found stated in the first number of the Magazine of Popular Science, recently issued in London. The paper purports to be on the subject of a new steam boiler, which is to be free from the danger of explosion.

The ideas of Mr. Perkins will, no doubt, have considerable weight, and, if any of them shall prove erroneous, will, by turning attention away from what *may* be causes of explosion, to what are certainly not, or the reverse, be productive of mischief. The truth or fallacy of most of his suggestions, may be tested by the experiments of the committee before referred to, which, if they had been devised to meet the case, could not have been more direct. I propose, in the following remarks, to point out the bearing of these results.

Mr. Perkins remarks, that, to show why his boiler will be free from explosion, the causes of these accidents must be described. He adds:

"The *first*, and most common cause, is from the pressure of common steam. What is meant by common, or pure steam, is such as has not been suddenly elevated, or such as is not compounded with an explosive mixture, by the improper management of the boiler."

"The first kind of explosion is harmless, as the boiler simply rends, or gives way, in the weakest place, caused from wear, or some defective spot."

That a boiler cannot be exploded by gradual increase of pressure, seems to have been a favourite idea with more than one author, and, indeed, our western engineers have almost made a proverb of it. That the committee, to whose labours I have referred above, entertained a doubt on this head, is obvious from their eighth subject of inquiry, which runs thus.†

VIII. To observe, accurately, the sort of bursting produced by a gradual increase of pressure within cylinders of iron and copper.

They burst one cylinder of iron, and one of copper, by a gradual increase of pressure, and, in both cases, produced a true *explosion*. The cylinders did not simply rend in a weak spot, but "*exploded violently*." The cuts accompanying the statements to which I refer, show how violent this action was. The head of one of the cylinders, the iron one, was thrown to the distance of fifteen feet; the other parts of the boiler, about six feet. Both the heads of the boiler were indented by striking against the iron cylinder in which the fire was made. The copper cylinder was rent in the direction of its length, and singularly doubled and indented by the violence of the explosion. The noise attending its explosion, is described by the committee as "like that from the firing of an eight inch mortar."

\* See the report of the Committee of the Franklin Institute, &c., Part I., published in this Journal, in January, February, March, April, and May, and in the documents of the Congress of the United States.

† Jour. Frank. Inst., vol. XVII., p. 223.

‡ Ibid., p. 224, and 225.

It is, then, conclusively shown, by these experiments, that Mr. Perkins is in error in his position; an error the more important, that it must bring in its train, inattention to regulating the pressure within a boiler, a belief in the safety of tying down, or overloading, a *safety valve*, and the like. Keep only the supply of water, and never mind the pressure, is the maxim which it inculcates; the worst that can happen, if the boiler gives way, is a simple rent in some weak spot; and, as a deduction, if there are no *weak spots*, the boiler will bear all that can be put upon it. This idea is of most mischievous tendency, and its spreading cannot be too soon checked.

Mr. Perkins next proceeds to the second cause of explosion. "The second cause of explosion, which I some years since accidentally discovered and published, and which explanation has since been experimentally proved to be correct, by the celebrated French philosopher, M. Arago, arises from the water getting too low in the boiler. The fire then impinging on that part of the boiler which is above the water, causes the heat to be taken up by the steam, which rises by its superior levity to the top of the boiler, causing it sometimes to become red hot, and so elevating the steam to a much higher temperature than its pressure would indicate. Now when the boiler is in this state, and the safety valve suddenly raised, the water will be relieved from the steam pressure, and rush up amongst the surcharged steam, which thus receives its proper dose of water, at the same time that part of the boiler which has been raised in temperature, giving off its heat to the water so elevated, steam is generated in an instant, of such force as no boiler hitherto made can resist. This kind of explosion has of late years been very frequent and disastrous, particularly in America."

There are so many assertions made in the paragraph just given, that it may be well to recapitulate them.

It is stated as a fact that explosions arise from the water getting too low in a boiler. That the reason why explosion takes place, is that the boiler is heated unduly, producing surcharged steam. That by raising the safety valve, water is thrown into the surcharged steam, and upon the hot metal; receiving heat from both, it is flashed into explosive steam.

That water may get too low in a boiler may readily be granted; then as to the consequences, we have the theory of Mr. Perkins, and the experiments of the committee before referred to. It may seem at first a matter of no great importance whether the hot steam or the hot metal flash the water into steam. It is the hot metal which is the source of the danger. But this will not bear examination, for among other reasons why we should be explicit upon this head, the temperature which may be reached without danger in the two cases, may be very different. Besides, if hot and unsaturated steam collected near the top of a boiler, is absolutely a necessary consequence of unduly heated metal, we may perhaps apply more simple means to determine the existence of danger, than when we are to determine the temperature of the metal of the boiler.

It was first shown by Dulong as a consequence of received laws of heat and vapour, that water thrown into hot and unsaturated steam, would not produce highly elastic steam. Others have repeated the proofs, but still practical men have doubted, probably overlooking the fact that these laws of heat are deductions from experiment, and therefore have all the authority of experiment. But the committee on explosions have made the direct experiment, and it tallies entirely with theory, so called. They raised\* steam to 533° of Fahrenheit's thermometer, when if "common steam," it

\*See Report at page 19, vol. XVII. Journ. Frank. Inst.

would have had a pressure of more than sixty atmospheres, but not having a full supply of moisture, its pressure was less than seven atmospheres. They injected fourteen ounces of water into this steam, which so far from flashing into highly elastic steam, lowered the pressure to six and a half atmospheres. This is one of many conclusive experiments leading to the same result. Hot and unsaturated steam then cannot *become* dangerously elastic by the projection of water into it.

If I understand Mr. Perkins aright in his statement respecting M. Arago, he certainly is in error. It is stated in the paper on explosions, by that philosopher, that his experiments referred to an increase of elastic force, within a boiler, accompanying the opening of a safety valve, and that in all the cases which he tried, there was a *decrease*, not an *increase* of pressure attending the opening. He however admits that his experiments were inconclusive, inasmuch as the boilers were not probably unduly heated. He further states that a decisive experiment was made by M. M. Tabareau and Rey on this subject, in which a boiler was unduly heated, and an increased pressure resulted from opening a safety valve. I shall resume this subject, having for the present occupied as much space as you will be disposed to devote to me. I consider the inaccuracy of two of Mr. Perkins's statements as proved by reference to the direct experiments of the Committee of the Franklin Institute.

First. That a gradual increase of pressure within a steam-boiler cannot produce all the most violent effects of explosion.

Second. That the projection of water into hot and unsaturated steam can produce highly elastic, or explosive steam.

Yours, &c.

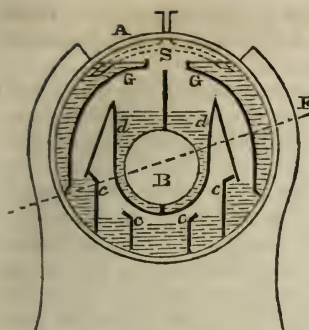
A.

### *Suggestions of Means calculated to promote Safety in Steam-Boat Boilers.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

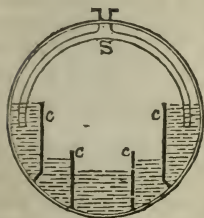
The steam-engine has, no doubt, been retarded in its race of usefulness, and in its applicability to the mechanic arts, by its liability to explosions, accompanied as this accident usually is, by so great a sacrifice of life and property. The existence of so great an evil should induce mechanical and scientific men to seek untiringly for the means of remedying so dangerous a defect. With this view of the importance of any proposed plan of prevention, which may appear feasible, I venture to offer some suggestions on this subject, merely premising that they are given to the public with much diffidence, but still with the hope that they may not be without value.

Many of the explosions of steam-boat boilers that have occurred, especially on the Mississippi, have been attributed to their internal flues, or furnaces, which becoming uncovered with water, by the rolling or continued leaning of the vessel, are rendered red hot, and produce that terrible effect of explosion, which seems to be so generally produced, when iron becomes thus heated, in the presence of water and steam confined. The following is a method proposed for keeping the whole fire-surface safely covered, by a quantity of water, which would be dangerously small, in a common boiler of the same extent of fire surface.



ver into *d d*; from this it runs down the inclined ledges into the side reservoirs *c c*, and so on to its lowest level. The imaginary line *F* shows the level which a steam-boat might assume, in a heavy gale, without uncovering any of the fire surface of water. In this position all the cells would be still supplied with water.

This description and drawing is here given, to show the extent to which the principle might be applied, although I am aware, that in practice it might be of doubtful success, except in large boilers, owing to its complicated internal construction, and the difficulty of cleaning when it had become foul from the saline matters of the water. With this view I proceed to describe a more simple arrangement. The figure represents the several metal divisions *c c c c*, and the branches of the supply pipe *S*.



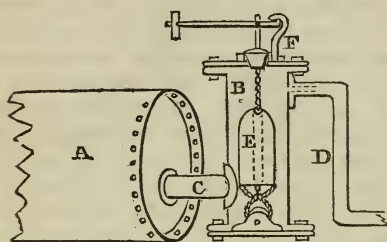
In boilers already in use, I conceive it would add to their safety, to place a single partition up the centre to the height of about two-thirds of the diameter, with branches to the supply pipe. It would not, however, furnish the advantages shown in fig. 2, where the same generating surface is obtained from water occupying but little more than half its natural space; and this gain in space adds about one-fourth to the room for the accumulating steam. It might be asked why the placing of a semi-cylinder within the boiler, and a few inches distant from the fire surface,\* would not give all the advantages to result from having a thin stratum of water near the generating surface. In such a case, it seems clear, that the generating particles at the bottom of this narrow chamber, would be quite as much pressed by the pressure of the fluid, as though the boiler was occupied by a body of water up to its diameter. The water surface should be as large as the actual fire surface, but in such an arrangement it would be but about one-tenth as large. There could not be a good circulation, and the generation would interfere with its own progress. The principle above described might be employed with advantage in stationary, as well as in steam-boat boilers, and in them the arrangement shown in fig. 1, would become more practicable.

I proceed to a second suggestion of what appears to me to be a durable and efficient apparatus, for lessening the danger of explosion in steam boilers. The inventor freely gives it for the benefit of the mechanical public; holding the opinion that any contrivance which has for its object the prevention of human suffering, death, and sacrifice of property, as a safety

\* As would be shown by the branches of the supply pipe in fig. 2, inverted.

apparatus has, should present too strong a claim to the humanity of an inventor, to permit him to retard its general application, by any pecuniary considerations, or exclusive privileges.

The method about to be described, proposes to supply the boiler with water, during the occasional stoppages of the steam engine, to which times, and to its attending circumstances, the explosion of boilers seem almost invariably to be traced. In the annexed figure, A represents a boiler, B an upright cylinder or reservoir for water; C is a tube entering the boiler just below the common water level, and making a communication between it and reservoir B; D is the induction pipe, through which the engine forces the supply of water for the boiler, into B. The action is supposed to be



this: the engine having been stopped, as will frequently happen, and in some cases, regularly, the water in the boiler, evaporates below the orifice of pipe C, the regular supply forced in by the engine, being cut off by its inactivity. Then, as fluids are still governed by the laws of density and gravity, under high pressure, the steam passing through the tube C, will rise to the top of B, permitting water equal in bulk to flow into the boiler, until the orifice of C is covered. It may be necessary that B be lined with wood, that the steam imprisoned may not be too much condensed, or the water will be forced back from the boiler. At the next discharge of water, however, this would be corrected. When the engine is again put in action, the cold water entering at D, condenses the steam in B, and fills it with water. The reservoir B may be made large enough to supply the boiler for one, two or more hours.

The imperfection that presents itself in considering this plan, is this: in case the water becomes all discharged from B, and the engine not set in motion at the end of a limited time, the boiler is as exposed to danger with as without the safety apparatus. To remedy this defect, the float E, and safety valve have been added. F represents the safety valve, with the lever and weight in the usual form, except that the seat or receptacle of the valve is turned with steps, so that the conical valve touches it at two or three points, all of which it has been ground to fit perfectly tight. It is conceived by this means, less liable to become disordered by the rusting of the valve or seat, or the accumulation of matters about them. From the bottom of the safety valve, a brass chain is attached, and descends through a hole made through the float E, and through a pulley, fastened to the bottom of B, and rising up again, it ends in two branches which are made fast to the float.

The float E is supposed to draw on the safety valve, with a buoyancy equal to 20 or 30 pounds, this combined with the pressure of the lever and weight, is equal to the maximum pressure maintained in the boiler. Now when the water is discharged from B, the float pressure of 20 or 30 pounds being taken off, the safety-valve rises, and continues to blow off steam until the engine is again set in motion, and B becomes filled with water. The steam which enters B will not be wasted, though condensed, the water when discharged, carrying the heat back to the boiler again.

*Notice of Coal Mines in Illinois.* By a CORRESPONDENT.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN—I have received the following information in relation to a locality of coal in Illinois, from Mr. Hall Neilson, of Richmond, Virginia, and consider it of sufficient importance to ask you to place it on the pages of your Journal for permanent reference. The coal alluded to is a dry bituminous coal, of which specimens have been placed in the Cabinet of the Franklin Institute, and of the American Philosophical Society.

The Mount Carbon Coal Mines are on the margin of Big Muddy River, near Brownsville, Jackson County, Illinois, a short distance from its junction with the Mississippi River. The upper stratum of coal which is now opened, and has been worked on a limited scale for many years, is about six or seven feet thick, and lies in a horizontal position above high water mark, leaving room for wharfage between the river and the mines. This coal combines the qualities of the *anthracite* with *pure charcoal*, with a remarkable freedom from sulphur, slate, and other impurities; makes an open fire, ignites very easily, and burns with much flame, and a strong heat, producing little smoke, cinder, or ashes. These rare qualities render this coal of great value and importance in the manufacture of iron and steel, and particularly so, in the production of *steam*. Coal must ere long, be generally adopted for the use of steam-boats, and sugar plantations, on the Mississippi, and for foundries, steam-mills, sugar refineries, cotton presses, and other works at New Orleans; there would, besides, if this coal were in the market, be a large demand for the outward bound shipping from that port, and as ballast for those in the Havana and South American trade, indeed the demand may be considered almost unlimited.

It is understood that the present proprietor of these mines wishes that their working should be undertaken by a company, to form which he has made arrangements.

A CORRESPONDENT.

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*Table of the Properties, &c., of the Metals, taken from a table by M. Chaudet, of the Paris Mint.* By FRANKLIN PEALE, Melter and Refiner of the U. S. Mint.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—The following table contains an abstract of the more important and interesting particulars relating to the metals. It is offered for publication under the belief that it will be useful as a matter of reference. The headings of the various columns are believed to be sufficiently explicit to guide the reader. A few of the less important, or more recently discovered, metals, are not inserted; their names are, however, given at the close of the table.

Yours, &amp;c.

FRANKLIN PEALE.

	Names of the metals.	Dates of Discover y.	Names of the Discoverers.	Names of the places where the principal mines are situated.
1	Antimony,	15th cent'y.	Basil Valentine describes the process for extraction.	In France, at Altemont; in Sweden, at Alteberg; in Hungary, in the mines of Cremnitz, and Chemnitz; in Bohemia, in Saxony, in Tuscany, &c.
2	Silver,	Earliest antiquity.		In France, at Altemont, St. Marie aux Mines; Saxony, at Freiberg; in Norway, Spain, Peru, Mexico, Siberia, &c.
3	Arsenic,	1733	Brandt.	In France, at St. Marie aux Mines; Saxony, at Freiberg; Bohemia, England, in the mines of Cornwall, &c.
4	Barium,	1807	Indicated by Davy.	In France, at Royut, (Puy de Dome;) England, "Anglesarcke," Saxony, near Freiberg; Siberia, Schlangenberg, &c.
5	Bismuth,	1520	Described in the treatise by Agricola.	In France, in Brittany, the Pyrenees; Bohemia, at Gonchienstad; Saxony, at Freiberg; Sweden, Transylvania, near Salatua, &c.
6	Cadmium,	1818	Herman, or Stromeyer.	In Hungary, in the "Bleude Rayonne" of Gazibram.
7	Calcium,	1807	Indicated by Davy.	In France, at Montmartre near Paris, Vizelle near Grenoble; England, in the county of Cumberland; Scotland; Spain, in the province of Estremadura.
8	Cerium,	1804	Hysinger and Berzelius.	In Sweden at Reddarhyta, in the mines of copper of Bastnais; Greenland, &c.
9	Chromium,	1797	Vauquelin.	In Peru, United States, Siberia, &c.
10	Cobalt,	1733	Brandt.	In France, in the Pyrenees, at Altemont; Sweden, at Tauxberg; Saxony, at Amaberg; Bohemia, at Joachienstat; Hesse; Spain, in the valley of Gistan, &c.
11	Columbium or Tantalum,	1802	Hatchet.	In Sweden, America.
12	Copper,	Antiquity.		In France, at St. Bel, near Lyons, Chessy; Spain, Piedmont, England, Germany, Hungary, Sweden, Siberia, North and South America, &c.
13	Tin,	Antiquity.		In Spain, near Monterey; England, co. of Cornwall; Bohemia, Saxony, East Indies, Banca, Malacca, &c.
14	Iron,	Antiquity.		In France, at the foot of the Pyrenees; Formoot in Vosge, Normandy, Burgundy; in Germany, Elba, Italy, Siberia, America, &c.

	Names of the substances with which the ore is united in the mines.	State in which they are found	Principal processes of reduction.
1	Sulphur and oxygen.	Native and mineralized.	After purifying the sulphuret, it is roasted with charcoal, "sel du soude," soda, and melted.
2	Antimony, arsenic, sulphur, mercury, oxygen, chlorine.	Native and mineralized.	The sulphuret is roasted with salt, heated with mercury and iron, and the amalgam distilled.
3	Oxygen, sulphur, several metals in the state of arseniates.	Mineralized.	By the calcination of the minerals which contain arsenic, this metal sublimes.
4	Oxygen, sulphuric and carbonic acids.	Mineralized.	By means of the voltaic pile, but obtained in very small quantity.
5	Oxygen, sulphur, and arsenic.	Mineralized.	Mineral bismuth is simply melted, and kept hot some time, to drive away the arsenic.
6	Oxide of zinc.	Mineralized.	The mineral zinc extracted by sulphuric acid, the Cadmium alone is precipitated by hydrochloric acid.
7	Sulphuric, carbonic, fluoric, and phosphoric acids.	Mineralized.	By means of the voltaic pile, but obtained only in very small quantities.
8	Oxygen, silica, and oxide of iron.	Mineralized.	The oxide is mixed with soot and oil, and melted in a strong fire.
9	Oxygen, oxygen and lead, forming the chromate of lead. Oxygen and oxide of iron.	Mineralized.	The oxide is mixed with soot and oil, and melted in a strong fire.
10	Oxygen, arsenic, iron, sulphur, nickel, sulphuric and arsenic acids.	Mineralized.	The oxide is mixed with soot and oil, and melted in a strong fire.
11	Oxygen forming the Colom-bic acid, oxides of iron, man-ganese, and itrium.	Mineralized.	By treating the Colombic acid as oxide of Cobalt is treated.
12	Oxygen, sulphur, carbonic, hydrochloric, and sulphuric acids.	Native and mineralized.	The sulphuret is roasted several times, then refined in a reverberatory furnace, the bottom of which is covered with a mixture of charcoal and clay.
13	Oxygen, sulphur.	Mineralized.	The oxide is pounded, washed, roasted, and treated afterwards in a furnace with powdered charcoal.
14	Oxygen, sulphur, carbon, carbonic, hydrochloric, and sulphuric acids.	Native and mineralized.	The oxide is pounded, washed, sometimes roasted, and melted in a high furnace, with fluxes of argil and lime; the cast-iron is afterwards converted into wrought iron.

	Names of the metals.	Colour.	Character.	Specific Gravity.	Degree of fusibility.	Action of heat and air.
1	Antimony,	Blueish white.	Brittle.	6.7021	431° Cent. therm.	Oxidable and volatile.
2	Silver,	Shining white.	Ductile.	10.4753	23° Wed.'s Pyrometer.	Not oxidable.
3	Arsenic,	Grayish white.	Brittle.	5.9590	Undetermin'd	Acidifiable & volatile.
4	Barium,	Undetermined.	Undeter'd.	Undeter'd.	Undetermin'd	Oxidable in the open air.
5	Bismuth,	Grayish white.	Brittle.	9.8220	256° Cent. therm.	Oxidable.
6	Cadmium,	Silvery white, approaching blueish.	Ductile.	8.6040	A little more fusible than zinc.	Oxidable and very volatile.
7	Calcium,	Undetermined.	Pulverulent	Undeter'd.	Undetermin'd	Oxidable in the open air.
8	Cerium,	Grayish white.	Brittle.	Undeter'd.	Infusible at the heat of the furnace.	Oxidable.
9	Chromium,	Grayish white.	Brittle.	Undeter'd.	Almost infusible at the heat of the forge.	Oxidable.
10	Cobalt,	Grayish white of tin.	Brittle.	8.5384	130° Wedg'ds Pyrometer.	Oxidable.
11	Columbium, or Tantalum,	Deep gray.	Pulverulent	Undeter'd.	Infusible at the heat of the forge.	Acidifiable.
12	Copper,	Redish yellow.	Ductile.	8.8950 8.6670	27° Wed's pyrometer.	Oxidable.
13	Tin,	White approaching that of silver.	Ductile.	7.2910	210° Centig'e therm.	Oxidable.
14	Iron,	Gray, with a blueish tint.	Ductile.	7.7880	158° Wed's pyrom.	Oxidable.

Action of acid with heat.

	Nitric of 40° Baumé.	Sulphuric of 66°.	Hydrochloric of 22°.
1	Very strong, converted into a white, insoluble oxide.	Feeble.	Very feeble.
2	Strong, solution complete.	Strong, and the solution complete.	No action.
3	Strong, converted into soluble arsenic acid.	Feeble.	Feeble.
4	Violent, solution complete.	Violent, converted into an insoluble sulphate	Violent, solution complete.
5	Strong, solution complete.	Feeble, forming a small quantity of white insoluble oxide.	Very feeble.
6	Strong, solution complete.	Complete solution.	Lively, solution complete.
7	Violent, solution complete.	Violent, converted into a sulphate almost insoluble.	Violent, solution complete.
8	Scarcely perceptible.	No action.	No action.
9	Scarcely perceptible.	Feeble.	No action.
10	Strong, complete solution.	Feeble.	Feeble.
11	Scarcely perceptible.	No action.	No action.
12	Strong, solution complete.	Strong, but the anhydrous sulphate is soluble in water.	Fusible, forming the hydrochlorate, soluble.
13	Very strong, converted into white insoluble oxide.	Feeble.	Very strong, solution complete.
14	Very strong, solution nearly complete, and forming an insoluble oxide.	Feeble; but with weak acid, solution complete.	Very strong, solution complete.

	Names of the metals.	Dates of discovery.	Names of the Discoverers.	Names of the places where the principal mines are situated.
15	Iridium,	1803	Descotels.	Always mixed in the mines with platinum.
16	Lithium,	1818	Arfwedson.	In Sweden, in the Petalite of the mine of Uto.
17	Manganese,	1774	Gahn & Scheele.	In France, at Aveline, (Vosges,) in the Perigueux, and the Romanesche; Saxony, Bohemia, Piedmont, Germany.
18	Mercury,	Antiquity.		In France, in Dauphiny; Spain, at Almaden; Germany, at Idria; Italy; Hungary, near Chemnitz; in America, in Peru, &c.
19	Molybdenum,	1782	Suspected by Scheele, proved by Hielm; also suspected by Bergman.	In France, in the Vosges, at the mine of Tillot, environs of Mont Blanc; Bohemia, in the mines of tin at Schlanckenwald; Saxony, Sweden, Iceland, &c.
20	Nickel,	1751	Cronstedt.	In France, in Allemont; Saxony, at Scheneberg, Armaberg, Freiberg; Bohemia, Joachinstat.
21	Gold,	Antiquity.		In France, in the valley of Doysan; the sands of several rivers on the continent, the Rhone, Garonne, &c.; in Spain, Germany, Hungary, America, North and South, &c.
22	Osmium,	1803	Tennant.	Always mixed with mineral platinum.
23	Palladium,	1803	Wollaston.	Always mixed with the mineral platinum.
24	Platinum,	1741	Wood, Assayer in Jamaica.	At Choco, at Barbacons, St. Domingo, in the bed of the river Yaki, South America, Spain, Russia.
25	Lead,	Antiquity.		In France, in Vienne, (Isere,) Poulhavuen, St. Sauveur, Languedoc, &c.; Germany, in Carinthia; Siberia, at Tarnowitz; in Spain; England, in Derbyshire, &c.
26	Potassium,	1807	Davy.	Wherever there exists lignious plants, particularly at Dantzic, in the Vosges, America, Russia.
27	Rhodium,	1803	Wollaston.	Always mixed with mineral platinum.
28	Sodium,	1807	Davy.	In France, Spain, in the plants which grow on the borders of the Mediterranean; Egypt; Hungary.
29	Strontium,	1807	Indicated by Davy.	In France, near Paris, at Menilmontat, Montmatre, Beauvoir, (Mance;) Pennsylvania; Scotland, at Strontian; Peru, near Popayan, &c.

	Names of the substances with which the ore is united in the mines.	State in which they are found	Principal processes of reduction.
15	Osmium, mineral platinum.	Mineralized.	By the humid process.
16	Oxygen, and mixed with petalite and tourmaline.	Mineralized.	By means of the voltaic pile, but in very small quantities.
17	Oxygen, sulphuric, and phosphoric acids.	Mineralized.	The oxide is mixed with soot and oil, and melted in a strong fire.
18	Sulphur, silver, hydrochloric acid.	Native and mineralized.	The sulphuret is mixed with lime, and heated in iron vessels; the mercury is volatilized.
19	Sulphur, oxygen, and lead, forming the molybdate of lead.	Mineralized.	By treating the Molybdic acid as the oxide of Cobalt is treated.
20	Oxygen, arsenic, iron, cobalt, sulphur.	Mineralized.	The oxide is mixed with soot and oil, and melted in a strong fire.
21	Silver, copper, sulphurets of iron and copper.	Native.	Sometimes roasted, and treated with mercury, and distilled.
22	Iridium, mineral platinum.	Mineralized.	By the humid process.
23	Mineral platinum.	Mineralized.	By the humid process.
24	Palladium, rhodium, osmium, iridium.	Mineralized.	It is treated by nitro-muriatic acid, and precipitated by muriate of ammonia, and the precipitate calcined.
25	Oxygen, sulphur, sulphuric, carbonic, phosphoric, hydrochloric, chromic, molybdic, and arsenical acids.	Mineralized.	The sulphuret is pounded, washed, roasted, and melted in a furnace with charcoal.
26	Oxygen, sulphuric, hydrochloric, carbonic, and nitric acids.	Mineralized.	By treating the hydrate of potash at a high temperature with iron.
27	Mineral platinum.	Mineralized.	By the humid process.
28	Oxygen, sulphuric, hydrochloric, and carbonic acids.	Mineralized.	By treating the hydrate of soda, at a high temperature, with iron.
29	Oxygen and acid, in the state of sulphate and carbonate.	Mineralized.	By means of the voltaic pile, but in very small quantity.

	Names of the metals.	Colour.	Character.	Specific Gravity.	Degree of fusibility.	Action of heat and air.
15	Iridium,	Silverish white.	Undeter'd.	18.6800 at least.	Infusible in the heat of the forge.	Not oxidable.
16	Lithium,	Undetermined.	Undeter'd.	Undeter'd.	Undetermin'd	Oxidable in the open air.
17	Manganese,	Grayish white.	Brittle.	6.8500	16 0° Wed'd. pyrom.	Very oxidable
18	Mercury,	White, appr'ing to silver.	Fluid.	13.5680	-39° Cent. th.	Oxidable and volatile.
19	Molybdenum,	Deep gray.	Brittle.	7.4000	Scarcely fusible.	Acidifiable & volatile.
20	Nickel,	Deep gray.	Brittle.	8.2790	160° Wed'd P	Scarcely oxidable.
21	Gold,	Pure yellow.	Ductile.	19.3610 19.2580 See note at end.†	32° Wed'd pyrom.	Not oxidable.
22	Osmium,	Powder black or blueish.	Pulverulent	Undeter'd.	Infusible in the heat of the forge.	Oxidable and volatile.
23	Palladium,	White, appr'ing to silver.	Ductile.	12.0020 11.6270	A little less fusible than iron.	Not oxidable.
24	Platinum,	White, appr'ing to silver.	Ductile.	22.6690 20.9800	Infusible in the heat of forge.	Not oxidable.
25	Lead,	Gray white, approaching blue	Ductile.	11.3520	260° Cent. th.	Oxidable and vitrifiable.
26	Potassium,	Grayish white.	Ductile.	0.86507	58° Cent. th.	Oxidable in the open air.
27	Rhodium,	Grayish white.	Brittle.	appears to be 11.0000	Intusible in the heat of the forge.	Not oxidable.
28	Sodium,	Grayish white.	Ductile.	0.97223	90° Cent. th.	Oxidable in the open air.
29	Strontium,	Undetermined.	Undeter'd.	Undeter'd.	Undetermin'd	Very oxidable

Action of acid with heat.			
	Nitric of 40°. Baume.	Sulphuric of 60°.	Hydrochloric of 20°.
15	No action.	No action.	No action.
16	Violent, solution complete.	Violent.	Very strong.
17	Slight, solution incomplete.	Feeble, but with a weak acid, complete.	Very strong.
18	Strong, solution complete.	Feeble.	No action.
19	Forming molybdic acid, a grayish insoluble powder.	Feeble.	No action.
20	Strong, complete solution.	No action.	Feeble.
21	No action.	No action.	No action.
22	No action.	No action.	Feeble.
23	Slight, but solution complete.	Very feeble.	No action.
24	No action.	No action.	No action.
25	Strong, complete solution.	Strong, converted into the insoluble sulphate of lead.	Feeble.
26	Violent, solution complete.	Violent, forming an insoluble sulphate.	Violent, solution complete.
27	No action.	No action.	No action.
28	Violent, solution complete.	Violent, forming an insoluble sulphate.	Violent, solution complete.
29	Very strong, solution complete.	Violent, forming an insoluble sulphate.	Violent, solution complete.

	Names of the metals.	Dates of Discovery.	Names of the Discoverers.	Names of the places where the principal mines are found.
30	Tellurium,	1782	Muller.	In Transylvania, at Offenbanger, Fatzbay, in the mines of Maria Lo-zetto.
31	Titanium,	1781	Gregor.	In France, near Limoges, at Allemont, Hungary, near Boinik; Spain, at Caju-elo; America; England, in Cornwall, &c.
32	Tungsten,	1781	Delhugart.	In France, in the department of Isere and Haute Vienne; Bohemia, at Zinn-wald; Saxony, at Ehrenfreidersdorf; Sweden, at Bilverg, &c.
33	Uranium,	1789	Klaproth.	In France, at Simphorien, near Au-tun, environs of Limoges; Bohemia, at Goachinsthat; Saxony, at Schverberg; England, in Cornwall.
34	Zinc,	1541	Indicated by Pa-racelsus.	In France, at Vizille, (Ysere,) Bagoo ry, (haute Pyrenees;) Sweden, at Dam-mera; England, counties of Somerset and Nottingham; Swabia, Poland, Hungary, &c.

	Names of the substances with which the ore is united in the mines.	State in which they are found	Principal processes of reduction.
30	Iron and gold, gold and silver, gold, silver, and sulphur, lead, sulphur, and copper.	Mineralized.	By the humid process.
31	Oxygen.	Mineralized.	By mixing the oxide with soot and oil, and melting in a strong fire.
32	Oxygen and lime, oxygen and iron, forming the "tungstates."	Mineralized.	By treating the acid of Tung- sten as the oxide of Cobalt.
33	Oxygen in the state of protox- ide and peroxide.	Mineralized.	By mixing its oxide with soot and oil, and melting in a strong fire.
34	Oxygen, cadmium, sulphur, carbonic and sulphuric acids.	Mineralized.	By treating the Calamium in closed vessels, with charcoal, the zinc sublimes, and is afterwards melted.

\* There are six others metals, whose existence was first admitted by analogy, or be- cause the matters from which they are extracted have the greatest resemblance to me- tallic oxides, viz: Magnesium, Glucinium, Lithium, Aluminium, Thorium, and Zir- conium. The existence of these metals has been proved, and others discovered, since this table was prepared.

	Names of the metals.	Colour.	Character.	Specific Gravity.	Degree of fusibility.	Action of heat and air.
30	Tellurium,	White, app'ing to silver.	Brittle.	6.1150	A little less fusible than lead.	Very oxidable
31	Titanium,	Redish brown.	Brittle.	5.3000	Infusible in the heat of the forge.	Oxidable.
32	Tungsten,	Blueish gray.	Brittle.	17.6000 17.5000	Almost infusible.	Oxidable.
33	Uranium,	Deep gray.	Brittle.	9.000	Almost infusible.	Oxidable.
34	Zinc,	Grayish white, approaching to blue.	Ductile.	7.1000 6.8610	370° Cent. th.	Oxidable and volatile.

## Action of acid with heat.

	Nitric of 40°. Baume.	Hydrochloric of 20°.	Sulphuric of 60°.
30	Strong, solution complete.	Feeble.	No action.
31	Scarcely perceptible.	No action.	Feeble.
32	Scarcely perceptible.	No action.	No action.
33	Strong solution complete.	No action.	No action.
34	Strong solution complete.	Feeble; but with weak acid, the solution complete.	Very strong, solution complete.

† Whenever two specific gravities are expressed, the first is that of the metal hammered or condensed, by rolling. Several other metals have been discovered since the date of this table, and several of the compartments marked undetermined, will be found in the last edition of Thenard.

## Physical Science.

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### *Second Report of the Joint Committee on Meteorology, of the American Philosophical Society and Franklin Institute.*

In commencing this report we have still to regret that the extent of our correspondence north-west and south-east is not great enough to enable us to ascertain the boundaries of our great storms in those directions; and of course we cannot determine the direction of the winds in those boundaries—a knowledge which we believe to be of the highest importance to the science of meteorology. The committee do not yet despair, however, of extending this correspondence so far as to attain so desirable an end, and with the hope of aiding this extension, proceed to give an account of a few of the most remarkable storms which have occurred since their first report.

These we are sure will be found to be highly interesting, even with the imperfect knowledge which our limited correspondence enables us to give of them. It will be seen that the character of some of them varies from our great north-east storms which come from the south-west. They seem to have travelled southwardly or south-eastwardly, as will be seen by the storms of the 14th and 15th of May, of the 20th of May and 19th of June.

It is much to be hoped that gentlemen throughout the country, who may see this report, will communicate to us any fact connected with the storms here detailed, which may either be favourable or adverse to the generalization upon which we have ventured.

It would be particularly desirable to know the boundaries of the great rain which took place on the 19th of June, to the north-east. For this purpose, if gentlemen living in Vermont and New Hampshire, and the north of New York, would consult their meteorological journals, and let us know whether it rained there at that time or not, and which way the wind blew, they would confer a great favour on the committee. From the nature of the remarks below, it will be understood what kind of information is wanted. We hope every gentleman to whom this is sent will be induced to furnish a faithful correspondent, who will at least carefully observe all storms, their beginning and ending, and the course and changes of the wind, during their progress. The labour, though great, of collating numerous journals, and deducing from them general conclusions, will be cheerfully continued by the committee. These journals are carefully preserved in the archives of the Franklin Institute, and will be accessible to any meteorologist who may wish to consult them.

We now proceed to detail the phenomena attending the most remarkable rains and storms which took place between the date of our first report and the eleventh of November, 1835; and to enable the reader to comprehend the report with greater ease, we recommend him to bear in mind this remarkable generalization—*In all the seven storms examined, the wind blew towards the point where it was raining.* To this rule there is not one exception; for though the very first storm mentioned, that of the 26th of April, terminated at Philadelphia, and passed on to the north-east, with the wind still from the north-east, it appears plainly that a much greater storm was raging at that very time at no great distance to the south-west, in the very direction towards which the wind was blowing.

The storm of the 20th of May was evidently too local in its character to form an exception. As it is known, however, that many of our summer

storms set in with the wind near the surface of the ground, blowing from the centre of the storm, it becomes a question of high importance to investigate the cause of this difference.

*Storm of 26th and 27th of April, 1835.*—On the night of the 25th and morning of the 26th of April, at *Philadelphia*, there was a great rain, with the wind at north-east. At the end of the rain the wind continued from the north-east with abated violence, being almost calm on the morning of the 27th, with the lower clouds from the west-north-west, and the upper clouds from the west. At three P. M. the wind was from the east, pretty fresh. At six P. M. a very great rain commenced, which continued through the night, the wind changing round by the north, and at ten the next morning it still rained very hard, with the wind from the north-west, and violent. The rain began to abate at seven, the wind being still violent from the west-north-west, and at eight the rain ceased, with the wind west-north-west, its violence having a little abated. The barometer was now rising rapidly.

At *Cape May*, on the night of the 27th, the wind was violent from the south.

At *Baltimore*,\* the rain was very great on the night of the 25th, and continued the most of the day of the 26th. The wind was north-east all day on the 27th. The rain began at three P. M. became very heavy at four, and continued so through the night. On the morning of the 28th, the wind was north-west, and scud and heavy cumuli were rolling off to the south-east. The wind was west in the afternoon.

At *Flushing*, Long Island, New York,† after the rain of April 25th and 26th, the wind continued north-east till half past two o'clock, P. M. of the 27th, when it was south-west. At six it was south, and at seven P. M. it changed suddenly to south-east. The rain commenced at nine P. M. and continued till half past twelve P. M. of the 28th. The wind was very high. In the morning was north-east, and at noon north-west, continuing so all day.

At *Middletown*,‡ Connecticut, after the rain of the 25th and 26th, the wind was variable till some time on the night of the 27th, when the rain commenced, and continued violent. The wind was easterly till eleven, A. M. when it changed to south-east, at noon to south, and at two P. M. to west, the rain continuing with unabated violence all the forenoon. From five P. M. of the 26th till noon of the 27th, the barometer fell more than an inch. The wind westerly in the afternoon.

At *Brown University*,§ Providence, Rhode Island. After the rain of the 25th and 26th, the wind hauled round by the north to north-west, and cleared on the evening of the 26th. On the 27th, the wind came round to the east in the afternoon, and the evening was cloudy. On the 28th, from three to four A. M. there was a heavy blow from the east, with copious rain; at ten A. M. the rain ceased, the clouds beginning to be broken, and the wind violent, hauling southerly. At one P. M. the wind was south-west, very heavy; at four P. M. the wind was westerly, its violence had abated, and the clouds were broken. The barometer began to rise. The weather cleared from nine to ten P. M. the wind having abated; on the next day the wind was westerly.

\*Our correspondent is Dr. G. Sproston, U. S. Navy.

†Our correspondent at Flushing is Mr. C. Gill.

‡Our correspondent is Mr. A. W. Smith.

§Our correspondent is Professor Caswell.

*Storm of 4th and 5th of April, 1835.—Brown University.* On the 3d of April, 1835, there was a great rain in the night, commencing between eight and nine.

On the 4th, at sun-rise, the wind was north-east, but during the morning it hauled to the north and north-west; towards night swung back to the north-east, and blew heavily during the night. There was a mist, but no rain.

On the 5th, at sun-rise, the wind was heavy from the north-east; there was rain occasionally during the day. From seven to eight o'clock, P. M. the wind came round to the south-west. The clouds had broken away at nine, and the sky was clear at ten.

6th, light shower at nine P. M. wind south-west.

*Baltimore,\* Maryland.* On the 3d, the wind was east, south-east and east. There was a light sprinkling of rain from two to four P. M. The sky was overcast in the evening.

On the 4th, the wind was east in the morning, south-east in the afternoon, with a sprinkling of rain at fifty minutes past ten, A. M. to twelve. The rain recommenced at nine P. M. with lightning, and continued with high wind through the night, turning to sleety snow at twenty-five minutes past nine, A. M. of the 5th, and terminating at fifty minutes past ten, A. M. with the wind east. At twelve the wind changed round to the west, with a heavy reflux of cumuli from the east. At sun-set the wind was south-west, with some rain; starlight at ten P. M.

*Philadelphia.* On the 3d and 4th, the wind and lower clouds were from the north-east, the upper clouds from the south-west, and middle clouds from south-west, with very hard rain, commencing some time in the night of the 4th, with thunder and hail; continuing on the 5th very hard, with wind east-north-east, violent till half past ten, A. M. The wind changing to east at eleven, blew less violently, and was south-south-east at one P. M. nearly calm; the lower clouds south. The wind was south at half past three P. M. strong from west-south-west at six P. M. strong on the 6th, the wind moderating a little. The rain ceased at noon; very little in the afternoon.

At *Flushing*, Long Island, New York. On the 4th, the wind rose at half past ten P. M. north-east, having been gentle in that direction for two days. It was very high the next morning in the same direction, at a quarter past seven; at quarter past twelve was very high from the east; at half past three brisk from the south-east, and at six high from the south-west. Rain commenced with thunder, at half past eleven, A. M. and with some intermission, ended at two P. M.

At *Baltimore.* On the 4th of May, at half past three P. M. a nimbus rose from the west, against a strong south-east wind; it burst at four, with thunder and lightning, and rained nine-tenths of an inch.

*Storm of May 15th, 1835.—Norfolk,† Virginia.* On the morning of the 15th, there was a great rain, ending at twelve o'clock. At *Philadelphia*, all that morning there was a strong wind and lower clouds from north, and upper clouds from south-south-west, continuing till four P. M. when the clouds disappeared. During the same morning, at *Brown University*, the wind was north-east; with misty rain till twelve.

At *Flushing*, the same morning, the wind was high from the north-east,

\*Our correspondent is Dr. G. S. Sproston, U. S. Navy.

† From the newspapers.

the lower clouds from the north-east, the middle from the north, and the upper from the west, and at *Cincinnati*,\* Ohio, south-west.

This rain seemed to have travelled south, for it ceased to rain at Philadelphia on the 14th, at half past twelve; with the wind changing from north-east to north, it continued to rain hard at Baltimore, at three P. M. and only ceased at four. Or as it rained a little on the 15th, at Brown University, till twelve, did it spread outwards in all directions from some centre?

At Portsmouth, sharp lightning south-east, at half past eight P. M.

*Storm of the 20th of May.*—This last appears to be the character of a rain which occurred on the 20th of May, at *Silver Lake*,† Pennsylvania. On this day, at one P. M. a violent thunder storm commenced, with hail, from the west, the day having been clear till that time.

At *Farmington*, Connecticut,‡ a violent storm commenced at four P. M. and lasted till nine.

At *Flushing*, a violent thunder storm began at five, and lasted half an hour, preceded by a squall of wind from the west, the wind having been all day west.

At *Brown University*, a light shower, with thunder and lightning, from six to eight P. M. wind south westerly all day.

At *Philadelphia*, about seven P. M. a strong wind commenced suddenly from the north-west, it having been pretty strong from the south-south-west all day; at the same time when the wind began to blow from the north-west, the lower clouds were coming from the south-west, and the middle clouds from the north-west; at eight o'clock it began to rain, barometer rising .05 of an inch in an hour. There was some thunder, but not much rain till some time in the night.

At *Baltimore*, it was clear on the 20th at ten P. M. and did not begin to rain till late in the night, and it continued showering the next day till a quarter past nine, P. M.

*Storm of July 15th, 1835.*—At twelve o'clock a violent rain, with hail, commenced at *Baltimore*, with the wind north-east, continuing till seven P. M. The course of the wind in the afternoon not given, but on next day it was west; on the same afternoon and evening there fell tremendous floods at *Woodbury*, New Jersey. At five P. M. when it was raining hard in New Jersey, the wind changed to north at *Philadelphia*, with very dense black clouds coming rapidly from the south, and at six o'clock a most violent rain commenced, lasting till about eleven P. M. with the wind from the north. During all this time there was a most violent gale at *New York*, from the north-east; the rain commencing there at nine P. M. while at *Washington City*, the wind continued all that day and the next, from the south-west, with rain on the 15th, at what hour not mentioned. At *Lancaster*, Pennsylvania, the wind was north, with rain, which is not stated, to have been remarkable. From the phenomena here recorded, it appears that the wind below at New York, Philadelphia and Washington City, was blowing towards a point in New Jersey, for several hours, at the same time when it was raining there most violently. The same was the case at Philadelphia, at least the clouds were coming thick and dark above, from the same point, while the wind below was going to that point.

\*From the newspapers.

†Our correspondent is Dr. R. H. Rose.

‡Our correspondent is Mr. James Porter Hart.

*Storm of November 11th, 1835.*—The particulars of this remarkable storm will be given hereafter in the Journal of the Franklin Institute; at present we will only say that at *Oswego*, in the south-east corner of Lake Ontario; at the *Ducks*, in the north-east corner; at *Buffalo*, and various other parts in the south-western part of that Lake, the wind, when it was most violent, blew for several hours towards a point in the Lake, near the eastern end, on the morning of the 11th of November, and it changed round by the south, on south side of the Lake, and by north, on north side, to westward.

The north-west corner of this Lake has not yet been heard from. Perhaps some gentleman in *Toronto*, or some place on the north side of the Lake, will have the goodness, on seeing this report, to send us the desired information.

*Tornado of June 19th, 1835.*—On the 19th of June, it rained all day at *Oxford* and *New York*, with the wind south in the morning, south-west in the afternoon.

North of *Albany* there was a very great rain, beginning about eleven, A. M. as we have been informed by Mr. Gynne, who was travelling there that day, and at *Albany* it rained 2.45 inches in the afternoon and evening; wind south in the morning, north in the afternoon.

*Brown University.* June 19th was clear in the morning, with the wind light from the south-west. The wind freshened towards night; the air very damp, with heavy fog clouds from southerly. Began to rain from eight to nine P. M. with wind very brisk from south-west. Rain 0.4 inches.

*Middletown, Connecticut.* June 19th, wind south all day; very strong in the evening; rain at noon, and a thunder shower commenced at six P. M. The barometer was lowest on the morning of the 20th; a gale all the next day from the north-west.

*Portsmouth, N. H.* June 19th, wind south at seven A. M. south-east at two P. M. and east-south-east at sunset. On the 20th, gale from half past eight A. M. till half past seven P. M. west by north, with rain from seven P. M. till three A. M. of the 21st; at seven A. M. of the 20th, lower clouds west by south, upper west-north-west; barometer lowest on the morning of the 20th.

At *Mr. Bloomfield's*, 4 miles east from Piscataway, New Jersey. June 19th, about ten P. M. the wind began to blow hard from the south-west, and increased in violence till about two A. M. of the 20th, when it began to abate, and about dawn was nearly calm; during all this time very black clouds, accompanied with terrific lightning, without thunder, almost incessant, were coming exactly against the lower wind from the north-east, or perhaps a little north of that point, with clouds occasionally meeting them, moving with the wind, and the interval between the very black clouds was so bright and silvery, that the stars could hardly be distinguished. About sunrise the north-east wind began to blow, and by eight A. M. had increased to a gale, perfectly clear; continuing violent till about twelve M. when it began to abate, and at two P. M. it had died away. Next day it was strong from the south-west.

19th. On this same day, about five P. M. a violent land-spout took place at New Brunswick and its vicinity. It appeared in form of an inverted cone of smoke, reaching the ground with its apex, and its base among the clouds; it lasted only a few moments in a place, and progressed easterly, a little north, with a slow motion, not more than twenty or thirty miles an hour; it was about two or three hundred yards wide, and within that breadth left neither trees nor houses standing; all the trees were thrown inwards, and generally forwards; many of the houses had their walls prostrated

outwards, and the shingles were thrown down in great numbers in Staten Island, along with a shower of hail and rain, from fifteen to twenty-five miles north-east from where they were taken up. During the fall of the hail, on the north side of the vein, the wind was strong from the south, and on the south side of the vein, the wind chopped suddenly round to the north, the wind having been south-west before. At the distance of a few hundred yards from the spout at its passage, the wind was not remarkably strong.

In conclusion, we recommend to our correspondents to observe and note every phenomenon which may tend to establish or refute the generalization to which we turned their attention at the commencement of this report. It is a remarkable fact, and altogether consistent with the generalization here spoken of, that all our great storms which set in from some eastern point, terminate with the wind from some western point; and our correspondents will recollect that all the phenomena detailed in our first report lead to the same conclusion. Among the storms there detailed, not the least remarkable was that on the 22d of March, 1835, in which there was a perfect calm at Philadelphia for several hours, with an extremely low barometer, the sky was very cloudy, without rain, while at the same time there was a most violent rain all round Philadelphia, with very strong wind towards Philadelphia.

Was the air at this moment rising over Philadelphia so rapidly as to carry up the drops of rain and throw them off at the sides of the ascending column? Both the rapid afflux of air towards Philadelphia, at that time, and the extreme depression of the barometer there, lead strongly to an affirmative answer. How extremely interesting would it be if our correspondence were wide enough to trace these storms to their commencement, and follow them to their termination.

And if our present attempt should fail to stimulate men of science to engage in the undertaking of investigating the dynamical laws to which the movements of the atmosphere are subject, and this can only be done by simultaneous observations over a wide extent of territory, then this committee, *unless aided by Government*, will have to leave the work unfinished, and reluctantly close their labours, with perhaps one more report.

JAMES P. ESPY, Chairman Joint Committee.

Charles N. Bancker,	}	Com.
Gouverneur Emerson,		
Alexander D. Bache,		
		Amer.
		Phil. Soc.

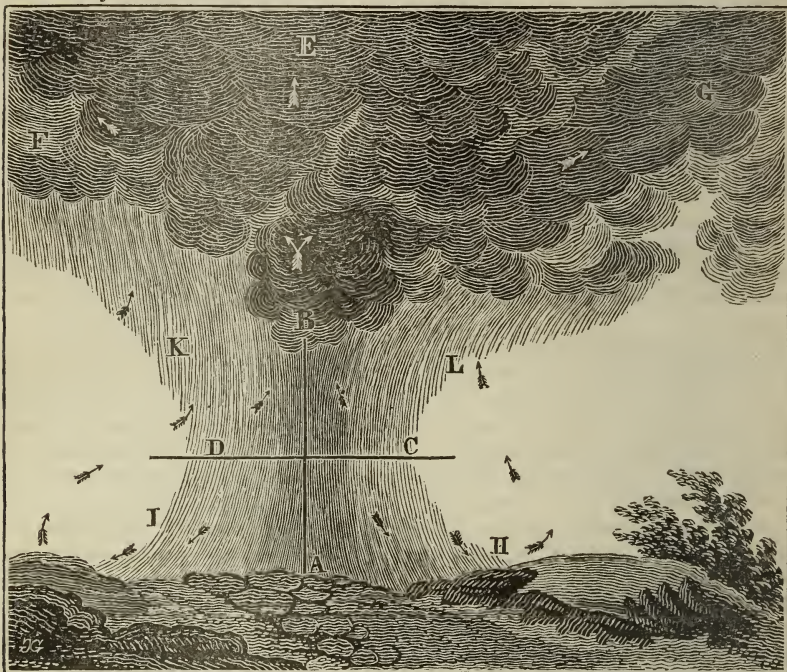
James P. Espy,	}	Com.
Alex. D. Bache,		
Henry D. Rogers,		
S. C. Walker,		
P. B. Goddard,		
		Frank.
		Inst.

*Remarks on the foregoing Report, by the Chairman of the Committee.*

The sudden change of the wind to the north-west, on the 20th of May, at Philadelphia, in the evening, about three hours after a violent hail storm and rain in the north-west, at Silver Lake, Pennsylvania, may be accounted for by the cooling effects of these depositions on the lower stratum of air, between the cloud and the earth.

If we suppose A, B, in the accompanying wood-cut, the distance of the lower part of a cloud, producing a violent rain, to be one thousand yards, and this whole stratum to be cooled down ten degrees of Fahr., which is a moderate allowance both as to height and temperature, the density would be increased about  $\frac{1}{30}$ th, and of course it would overbalance, by its superior weight, the columns of air on the outside of the rain, at I and H, and move outwards from the centre of the storm, at the surface of the earth, with a

velocity due to a head of pressure of  $\frac{3000}{50}$  feet, or  $\sqrt{8 \times \frac{3000}{50}} = 62$  feet per second. Whenever a hard shower takes place from a lofty cloud of moderate diameter, such will be the effect at the surface of the earth. For as the perpendicular diameter of a cloud, which produces a very hard rain, must be great, the drops of rain must descend from a great height, and will enter this lower stratum of air very cold, sometimes frozen; the effect will manifestly be as stated above.



This explanation will apply most satisfactorily to the gale which took place at Portsmouth and Middletown, from north-west, and in New Jersey, near Amboy, from the north-east, on the morning of the 20th of June, after a most violent rain, which fell on the evening and night previous, in the eastern part of New York, all round Albany. The wind in all these places blew outwards from where the rain had fallen.

The air in New Jersey was described as piercingly cold, and at Portsmouth, New Hampshire, it was fourteen degrees colder than on the day before at the same hour.

The reader will observe that the clouds below at Philadelphia continued to move from the south-west. on the 20th of May, after the wind changed round to the north-west, while at the same time an upper stratum of clouds was coming from the north-west.

The whole phenomena of this storm, and others of moderate diameter, where the cloud does not descend very low, as it did on the 19th of June, will be clearly comprehended by supposing that there is an inward motion of the air at the lower part of the cloud, an upward motion in the cloud, and an outward motion in the upper part of the cloud, as indicated by the arrows in the wood-cut.

This upward motion also, if it could be shown how it is effected, would account for the condensation of the vapour into rain by the diminution of

temperature resulting from diminished pressure, which it is known amounts to at least one degree Fahr., in the case of dry air, for every hundred yards of ascent.

The wood-cut is intended to represent only those storms of moderate size in which the cloud is of sufficient height to let the air below become so cooled as to produce an outward motion at the surface of the earth. There are, however, two other cases in nature, in which the wind at the surface of the earth blows inwards. First, when the cloud reaches down to the surface, or near the surface of the earth, as in the Brunswick spout. Second, when the cloud is of very wide extent, and the rain general; in which case the air to supply the storm with vapour or steam, cannot find room to enter under the cloud without carrying in with it all the air between the cloud and the surface of the earth.

These three kinds embrace all the varieties of storms in nature. Now as the characters of these three kinds of storms are very distinct, and as it will be very convenient hereafter to speak of them separately, I propose to call that kind which is very narrow, and having the wind blowing inwards at the surface of the earth, primary; that one which is of mean size, and has the wind blowing outwards at the surface of the earth, secondary; and that which is very wide, and has the wind blowing inwards at the surface of the earth, tertiary. The choice of these names arises from the theoretic probability that all storms commence with the first character, pass into the second, and terminate with the third.

JAMES P. ESPY.

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*Review of Mitscherlich's Compendium of Chemistry, with remarks on the method of teaching Chemistry.* By JAMES C. BOOTH.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Among the votaries of any science, a lively interest is naturally felt in the publication of works connected with that science; a feeling greatly enhanced by the circumstance of their proceeding from men of high reputation. This is more particularly the case with chemistry, which is daily increasing under the hands of its followers, by the accumulation of new and important facts, and by the proposal of new theories to account for the phenomena. Numerous works in this science, of greater or less comparative value, are yearly brought before the tribunal of public opinion, and yet there are but few which do not either wholly fail of success, or which have more than a limited circulation. The cause of this is not so much an ignorance of theory on the part of the author, as the want of sufficient practical knowledge to enable him to put much of his theory to the test. As chemistry is a science of facts, so it cannot be learned without seeing them, nor taught without being able to exhibit them; hence it is that he who has experimented himself, is better able to describe the results of his operations, than he who describes phenomena of which he has only heard or read; for the former gives the more striking impression, which the experiment made on him, the latter the impression as derived from a description. Another cause operates to render the great majority of works in this, as in other sciences, unsuccessful; they are destitute of uniformity of execution. Too few authors, in commencing a work, are themselves aware of their object, or if they be aware of it, pursue it with that uniform and steady aim which is absolutely necessary to its complete success; hence many otherwise excellent treatises are rejected for this reason alone, while others of inferior merit, but exhibiting uniformity of purpose, rise above and even supersede them. "Whoever would please every one, pleases no one," does not lose its force by repetition, for there is no single work on chemistry suited to every class

of readers or of students, nor can it indeed be anticipated in a science embracing such an infinite number of facts, and such a variety of objects. What interest does the miner, or the smelter of metals take in organic chemistry? Of how little real utility to the pharmacist or manufacturing chemist are discussions relative to the subtle theories of the science? Is it necessary for the purely theoretic chemist to be acquainted with all the details of the manufacturer? How little has the student, when commencing, to do with all these? Lastly, where is the chemist who can embrace them all with the same energy as when devoted to one only? Therefore I contend for unity of purpose, and uniformity of execution, and I think the answers to the foregoing questions will be found conclusive.

A work on chemistry has lately appeared to which the name of its author alone would ensure success, though not perfectly free from the faults I have above endeavoured to point out; for notwithstanding these, it possesses merits of a peculiar kind, entitling it to consideration. Whoever would call over the names of chemists of celebrity, of the present day, and omit in his catalogue that of Professor Mitscherlich, of Berlin, the founder of the doctrine of isomorphism, would do great injustice to him and to the school to which he belongs. For although this doctrine be not fully developed, it has nevertheless been resorted to with success, for correcting former errors, and strengthening certain theories, and promises to become an important agent in disclosing the hidden operations of nature. All that we have hitherto known of Mitscherlich are a few treatises, through the medium of their French translations, and we are now introduced to him as the author of a "*Manual of Chemistry*." I propose giving a sketch of the subjects contained in the first part of the first volume, (for the whole has not yet appeared) and would wish to draw the attention of the reader at the close, to a few remarks on an important subject, viz. the method of instruction to be pursued, in communicating the facts of chemistry to the uninitiated.

The work commences without preface or introduction, the first page containing an enumeration of the elements with which we are acquainted, and the second thus unceremoniously introducing oxygen to our notice: "If red oxide of mercury be heated in a retort, the neck of which passes through a cork in one opening of a receiver, then, through a tube fitted in another opening, bubbles of air will pass and displace the water contained in an inverted cylinder." This is accompanied by a wood cut representing the apparatus, and a detailed description of the entire operation. A few deductions are then drawn from the experiment, viz: that there is a metallic body liquid at common temperatures; that there is a gaseous body differing in its properties from common air, this being shown by transferring a part of the gas into a smaller vessel, and holding a cinder of wood in it—that these two are held together by a certain power, which is termed affinity, and similar conclusions, such as a reflecting student might be supposed to make for himself. The same experiment is then supposed to be arranged in such a manner, that the resulting metal and gas may be weighed, from which the conclusion is drawn, that the red oxide is composed of certain quantities of the two substances alone, so combined that their individual properties cannot be detected, and in this simple manner the first clear views of the effects of affinity are communicated.

The method of preparing oxygen for practical purposes, from the black oxide of manganese, is next minutely described, together with the iron retort and gas-holder employed in the operation. A large number of experiments are exhibited by Professor Mitscherlich before his class, which are

not detailed in the work, his object in doing so being the desire of keeping this first element before the student as long as possible, until the latter shall have fully made its acquaintance by a knowledge of its properties, thus proceeding upon the well established principle, that the mind lays hold of an entirely new subject by slow degrees.

The powers of combination possessed by oxygen are now mentioned, and its compounds with manganese adduced as examples of the union of one body with different proportions of another, as if to break the ground for the reception of the difficult truths relative to combining proportions, and the section is concluded by a numeral representation of the five oxides of manganese, and the three of lead.

The whole is illustrated by eleven wood cuts, representing the apparatus, with the mode of employing it.

I have dwelt more particularly on this first section, that it may serve as a specimen of the remainder, and as I wish to recur to it at the close for the elucidation of a few points, of which I intend to treat.

Hydrogen, and its combination with oxygen, are next introduced, and an experiment arranged to show the composition of water, from which the student obtains an idea of the theory of volumes, and a clearer view of the atomic constitution of bodies.

Nitrogen, and its combinations with oxygen and hydrogen, are mentioned, but not specially treated of, as the former will be found, according to the arrangement adopted by Berzelius, among the acids, the latter with the alkalis.

The peculiar properties of sulphur are now described, and as one of them, its power of crystalizing in certain forms, from which naturally flow observations on the regular forms of bodies. The solid, liquid and vaporous states are exemplified in the body before us, and the section closes with the method of obtaining and purifying it in the large way.

Selenium and phosphorus are slightly noticed, only the combinations of the latter with sulphur and hydrogen being given. Mitscherlich advances the theory that the difference between the two kinds of phosphuretted hydrogen lies merely in a small quantity of phosphorus dissolved by the self-inflammable variety, adducing as an argument the fact that hydrogen in contact with phosphorus for a length of time, takes up a small quantity, causing it to phosphoresce when exposed to the air. According to Rose's analysis, they are chemically the same, and they may be converted into each other by means which we have not as yet wholly in our power. But Mitscherlich's theory does explain how the non-inflammable is sometimes converted into the inflammable variety. It appears to me probable, that the non-inflammable phosphuretted hydrogen is a definite compound, in which the two substances are combined with such force, as not to inflame under common circumstances, but that certain causes operate to decompose it, forming another compound of hydrogen and phosphorus, by which a portion of phosphorus precipitates and is *dissolved* by the new compound, rendering it phosphorescent by the state of minute division of the phosphorus. The union of oxygen in the air with the dissolved phosphorus produces heat, and this in sufficient quantity, inflames the whole. By the reverse action, the dissolved phosphorus is again taken up into chemical union, and forms the non-inflammable variety, and I think that this is the only way in which we can explain the reconversion of one into the other, and their identity as given by analysis.

Chlorine, with its combinations with nitrogen, sulphur, and phosphorus, bromine, iodine and fluorine, follow in succession. An easy method, unat-

tended by danger, of preparing iodide of nitrogen is described, which shows the composition of this class of bodies. A small quantity of nitro-hydrochloric acid is introduced into a test-tube, and a few particles of iodine digested in it at a gentle heat. A part of the oxygen of the nitric combines with hydrogen of the hydro-chloric acid, while the liberated chlorine unites with iodine, forming a brown solution. If ammonia be added to this solution, the chlorine of the chloride of iodine unites with the hydrogen of the ammonia, while the iodide of nitrogen precipitates as a dark brown powder. It is filtered, and the paper, while wet, torn into small pieces and dried.

The diffusive nature of the remarks on phosphuretted hydrogen, while the sulphuretted is passed over in silence, is excused upon the plea, that "the latter belongs more properly to the acids." I think, however, this gas might have been exhibited to keep up in the student's mind the chain necessary to a clear comprehension of the subject.

A too strict adherence to the rule of describing "all the non-acid metalloid compounds in this place," brings our author into difficulty, for the introduction of many of them is premature, as regards a majority of those for whom the work was intended, that is, for beginners; and accordingly, after describing cyanogen, we have a full account of the combinations of oxygen, hydrogen and carbon, followed by a description of fifteen compounds of hydrogen and carbon, and these again by the combinations of chlorine, bromine and iodine, with the preceding. The author, as if aware of having committed an error, says, "I have considered it proper to mention a large number of compounds in this place, and enough in relation to each of them to excite some degree of interest," and offering as an apology that the "reader will soon discover that a continued examination of these substances is of the highest importance, inasmuch as it may be the means of enriching the science with many interesting facts." But he does not stop here, for after very properly describing the sulphuret of carbon, we are introduced to certain compounds of oxygen, hydrogen, nitrogen and carbon, viz. to the *amids*, which close the long section on carbon. There are eighty-four pages devoted to carbon and its compounds, and only seventy-nine to all previous substances, a circumstance so out of character with the whole tenor of the work, and to the principles which originated it, that we feel ourselves led to inquire into the reason of this deviation. I offer the following very simple solution; first, that this subject, in all its bearings, is at the present moment in the hands of the most distinguished chemists, necessarily giving birth to important facts, which ought to be communicated to the scientific world as soon as possible; and second, that Mitscherlich, with his wonted ability, has himself investigated many of the above compounds, and has deviated from the principles on which the work was commenced, from a desire to make known his discoveries. That this was actually the case, I do not assert, but such are the conclusions to be drawn from a review of the Manual.

A description of borium and silicium closes the first general division of the work, viz. the metalloids and their non-acid mutual combinations.

The remainder of the first part of the first volume is occupied by, first, the general properties of air and the gases, and second, those of water, and collaterally of solid, liquid and aeriform bodies. To gain a just idea of the plan of the whole, it will be necessary to enter a little into detail. The author observes, when introducing the subject, "it appears to me to be more conducive to my end as it certainly would be more intelligible, to bring together in this place what is more general in its nature, and what has been often repeated in the foregoing, after a series of experiments have been

instituted, and many phenomena exhibited." I may however observe that the arrangement is not altogether original with Professor Mitscherlich, it being merely a modification of, perhaps an improvement on, the plan adopted by Berzelius in his large work on chemistry. While the former has neither preface nor introduction, the latter precedes his system by a somewhat cursory notice of light, heat and affinity, and a rather long article on electricity and electro-magnetism. Berzelius follows the metalloids by the general properties of gases and liquids, which subject is considerably expanded by Professor Mitscherlich, as will be seen presently.

A description of the air-pump, followed by the mode of determining the specific gravity of gases, naturally leads to an account of the pressure of the air and its measurer, the barometer. Mariotte's law of compression, and that of expansion are properly here introduced, and we are now prepared to determine the composition of the air by means of hydrogen.

The mixture of gases, and the circulation of oxygen precede an important subject, namely, the examination of substances composed of oxygen, hydrogen and carbon.

I propose hereafter to give a translation of the article on the ultimate analysis of organic substances, which, however, I must remark, I think is rather out of place, in the commencement of a work adapted to instruction.

Flame, the distillation of wood and coal, lamps and furnaces, are next minutely described, and close the general properties of air and the gases. A little reflection will, I think, show us that the greater part of the subject is much more intelligible now, than it could have been previous to the exhibition of the metalloids and their compounds, and though perhaps some of the preceding and following articles might have been omitted with propriety, yet I contend for the superiority of the plan in an elementary work, of first introducing substances, and then the laws by which they are governed in their various actions and relations.

The properties of ice, the specific gravity of solids and liquids, and their relations to heat, are succeeded by a subject on which much of the atomic theory depends, viz; the determination of the specific gravity of vapours; in order to ascertain whether the relation between the specific gravity of the solid and its atomic weight is the same as that between the vapour of that body and its atomic constitution. From the experiments of Mitscherlich and of Dumas, it would seem that from the specific gravity of the solid, we cannot draw conclusions as to that of the vapour; hence we cannot say that if a certain weight of carbon unite with a certain weight of sulphur, then so much of the vapour of carbon will unite with so much of the vapour of sulphur. But the difficulties attending such researches are too great to allow us to receive the results with implicit faith, and it is therefore advisable to await the confirming experiments of others in this most important of all subjects connected with the atomic theory.

The pressure of vapours, and by an easy transition, the theory of the steam-engine, are next treated of, and the remainder of the volume is occupied by the general relations of solids to solids, of liquids to liquids, and of these to gases, under which we find capillary attraction; solution, with an interesting table to be seen in Professor Beck's work on chemistry; precipitation; filtration; edulcoration; the antiseptic properties of charcoal; condensation of gases by solids and liquids; many of which subjects are treated of in an original manner by Mitscherlich, and it may be advisable to offer them at some future time, in order not to lengthen this essay too much. I now close the analysis of this first part of Mitscherlich's work, and proceed with the inquiry started at the commencement of these remarks.

A close and careful examination of the section on oxygen brings us to a very important conclusion as to the manner in which the science of chemistry may and ought to be taught. That there is at present a deficiency in regard to our elementary instruction in chemistry, every teacher is well aware, and hence in selecting a work for his classes, he chooses "that which is least exceptionable," thus plainly indicating the difficulty with which he has to contend; but so universally is nearly the same plan adopted, that almost every one arrives sooner or later, at the conclusion that "a student, when commencing, should have some previous knowledge of the subject." Now we are not to suppose our readers totally ignorant of numbers, nor destitute of a general elementary education, but we must suppose them ignorant of the peculiar nature of solids, liquids and gases, that there are invisible bodies around us whose properties render them tangible, that all the bodies seen in nature are composed of a few elements. We ought to suppose that they cannot properly distinguish between the metals, earths, or alkalies, and even that they have no definite idea of what a metal is; and yet, aware of this, how few give a course on chemistry, without preceding it by a long series on heat, light and affinity. In describing the conducting powers of solids, can the student fully understand the subject, when many solids are mentioned, which are quite unknown to him? Can he under like circumstances, fully comprehend the doctrine of the capacity for heat, the pressure of vapours, solution, distillation and the like? What does he know of the bodies quoted to illustrate these general laws, and without which they cannot be understood? Much less is he prepared to encounter the theory of flame, the construction of lamps and furnaces, subjects of great importance to every one, though they are necessarily lost, because the terms used in description, the essential terms have not been defined. But the most unaccountable of all seems to be the development at the commencement of a chemical elementary work, of the laws governing the combinations of bodies both by atoms and volumes. In the tables of elective affinity, what does the student know of sulphuric acid, of baryta, strontia, soda, &c. or of a salt, when he is ignorant of its constituents? He no doubt conceives one body to be pulling others with different degrees of force, but it is next to impossible he should have more definite ideas on the subject than this; and yet a reference to our chemical works will show that these doctrines are introduced, and being theoretic, the reasons for and against the theory are usually brought forward and illustrated by a multitude of examples. Experiments are at the same time instituted by way of proof; but I ask, does not this savour of the mystery of the adepts in alchemy, to exhibit a striking effect, and withhold the cause; for what difference is there between withholding the cause altogether, and explaining it in language known to be unintelligible.

But to proceed farther, can a student master the subtle doctrines of affinity, when those more advanced experience some difficulty in reasoning upon them? For example, the first law of Dalton, that "the composition of bodies is fixed and invariable, must be illustrated by a number of well selected facts. Suppose we take sulphuric acid, which is generally brought forward for this purpose. It is an acid; what notion does the beginner form of an acid? When exhibited to him, he conceives it to be something like an oil, which will corrode animal and vegetable matter. To show its bearing on the above law, he is informed that it is always composed (a novel idea to him) of 16 parts by weight, of sulphur, and 40 of oxygen, and that the sulphuric acid formed by the hand of nature ages ago, and that made

artificially at the present day, have precisely the same qualities. With what a multitude of new ideas is he here overwhelmed, that there is an invisible substance, which may be weighed out and made to mingle with a solid, so as to form an acid, in which we cannot detect one of the individual properties of the constituents. It were useless to give more instances, for every one must be struck with the impossibility of rendering a definition intelligible, where the defining terms are not understood, and with the inconsistency of teaching according to this method, while at the same time the instructors must be aware that all their efforts cannot be crowned with success. The remarks made on the first law of combination will apply to the two remaining laws, although the difficulties are increased ten-fold, and I would beg the attention of instructors to this subject; nay, more than this, as our science requires us to "question nature and she will answer us," so I would propose the same principle in this case. Let those interested in the inquiry, experiment for themselves; let them strike out a course founded upon the principle, that "a beginner is wholly unacquainted with the subject," and let them closely observe its effects upon the student, for in this, as well as in other kinds of knowledge, a reflecting and inquiring student often leads us to observations which might otherwise have wholly escaped us, and which may induce important results.

The system adopted by Berzelius, and founded on this principle, was eagerly seized by others, and advantageously extended by Mitscherlich in his *Compendium*, the commencement of which, the section on oxygen, and a few succeeding, were conceived and executed in a masterly style. He first exhibits an experiment, a fact, and then makes such deductions as naturally flow from it, making the student acquainted with names in connexion with facts. The constant mention of a great number of names, heard for the first time, and without knowing the properties of the substances named, only tends to create a confusion in the mind at the threshold of the science, in the very place where the utmost clearness and precision are requisite. Again, observation teaches us, and it is a received opinion, that we acquire ideas of things before abstract ideas, before we can reason on those things. This is a strong argument in support of my position, but is too generally acknowledged to require amplification.

The whole of Prof. Mitscherlich's *Compendium* is not conceived with the same energy, and only shows the difficulty of writing with a manifold object in view. For instance, a majority of the compounds described under the article carbon, might have been advantageously deferred to a future portion of the work; there existed no necessity for such diffuse remarks on the general properties of the solids, liquids, and gases, inasmuch as they break in upon the chain of elementary substances, turning the attention from the principal objects to those of minor importance, at least less so in the commencement. The article on organic analysis is wholly misplaced, and only intended for those much farther advanced in the science. The same might be said of many other portions of the work, which inevitably leads us to the conclusion, that it was written for different classes of hearers, and for different purposes. On this point, I refer to my remarks in the introduction to this paper, where I attempted to show, in a concise manner, that a work on chemistry should possess unity and uniformity of plan, object, and execution. Be this as it may, the present volume of Mitscherlich's *Compendium* is a valuable addition to the chemist's library.

*Philadelphia, May, 1836.*

## Bibliographical Notice.

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*A Treatise on Astronomy, by Sir John Herschel, &c. &c. A new edition, with a preface, and a series of questions for the examination of students, by S. C. Walker. Philadelphia: Carey, Lea & Blanchard. 1836.*

The present edition of this popular work on astronomy is adapted to the use of students in academies, by the addition of a judicious set of questions for examination; a labour of the editor which will be appreciated by teachers. We have been much gratified by a perusal of the preface to this American edition, in which several interesting questions in astronomy are ably discussed. The principal of these are, the extension of the Newtonian law of gravity to the double stars, the correction in the mass hitherto assigned to the planet Jupiter, and the existence of a resisting medium throughout space.

In the first of these, the editor has done that justice to the labours of Sir John Herschel, which the author's characteristic modesty prevented him from doing, and further informs us of the result of some of his astronomical labours at the Cape of Good Hope. Both the other subjects are treated in a like interesting way, and the evidences in favour of the number assigned by the present astronomer royal of England, Mr. Airy, to the mass of Jupiter, are well put forth. The discussion in regard to the resisting medium, as evidenced by the acceleration of the three bodies most liable to its influence, known as Encke's, Biela's, and Halley's comets, leads the editor to the conclusion that "Encke's hypothesis of a resisting medium, is, according to the present state of the science, involved in new perplexities, for it is found, by trial, that no single estimate of the density of this medium, or of the law of its resistance will satisfy the observations of all three of the comets which are most liable to its influences."

The scientific, and even the general, reader, will find this preface to repay him for adding this edition to the former one, should he already possess it.

B.

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## Franklin Institute.

### *Monthly Conversation Meeting.*

The seventh monthly conversation meeting of the Institute, for the season, was held at their Hall, March 24th, 1836.

John Vaughan, Esq., presented samples of sugar obtained from beets, and made some statements respecting the cost of its production in France, and the practicability of introducing the manufacture into the middle sections of the United States.

Prof. W. R. Johnson performed some interesting experiments with an electro-magnetic apparatus.

Mr. George Goodman exhibited a Ruthven printing press, of very neat form.

Mr. Hall Neilson exhibited several specimens of a dry, bituminous coal, from the state of Illinois, remarkable for the readiness with which it ignites.

*Franklin Institute Quarterly Meeting.*

The forty-ninth quarterly meeting of the Institute was held at their Hall, on Thursday, April 21st, 1836.

THOMAS FLETCHER, Vice President, presiding;

ISAAC P. MORRIS, Recording Secretary, P. T.

The minutes of the last quarterly meeting were read and approved.

Donations of books, maps, and charts, were presented by Messrs. Carey, Lea & Blanchard; Adam Ramage; John C. Trautwine; Charles Roberts; Professor A. D. Bache, and Major Hartman Bache, of Philadelphia.

Donations of minerals, from Mr. John C. Trautwine, and Prof. W. R. Johnson, of Philadelphia, and from Mr. H. Neilson, of Richmond, Va.

John Vaughan, Esq., of Philadelphia, presented a specimen of sugar, made in France, from the beet.

The New York Gold and Silversmiths' Temperance Society presented a copy of their constitution and by-laws, and their certificate of membership.

Constant M. Eakin, Esq., of Philadelphia, presented specimens of zinc, made from the Pennsylvania ore, and of brass, made with the zinc, under the direction of F. R. Hassler, Esq., intended for the fabrication of weights and measures for the United States.

The Actuary laid on the tables, the periodicals received in exchange for the Journal of the Institute, during the past quarter.

The Chairman of the Board of Managers presented the forty-ninth quarterly report of the Board, which was read and accepted, and, on motion, referred for publication.

The Treasurer presented his quarterly report of the finances of the Institute, which was read and accepted.

Extract from the minutes.

THOMAS FLETCHER, *Vice President.*

ISAAC P. MORRIS, *Rec. Sec. P. T.*

*Report of the Board of Managers.*

The Board of Managers respectfully submit to the Institute, their forty-ninth quarterly report.

During the past quarter, the courses of instruction have closed, having been attended with their usual success. The want of accommodations, severely felt last year, has, however, tended to diminish the numbers of the class during the present year; a fact which should rouse the members to additional exertions in completing the arrangements for the new hall.

The Professor of Chemistry has evinced his ordinary zeal, and, amid the pressure of manifold professional engagements, has found time to devote to the instruction of his class. His lectures have given great satisfaction.

The Professor of Natural Philosophy has diversified the subjects of his course, even more than usual, during the past year, and his lectures have been well attended.

The Board return thanks to Mr. James C. Booth, for his volunteer lectures on the manufacture of porcelain. It is much to be regretted, that, among so many members of the Institute who are able to contribute to the information of their fellow members, so few are found to volunteer in the cause.

It will be the study of the Committee on Instruction, to endeavour to give more extent to the system of lectures, by supplying the nights vacant from the want of volunteer lectures.

The Drawing Schools have greatly flourished during the past year. The number of pupils in the two departments has been seventy-eight, many of whom have taken tickets for two quarters.

The apathy which has prevailed in regard to the English School, is calculated to discourage both the excellent instructor, who has presided over it, and the managers who have so often urged its claims upon the members.

As of great importance to the future welfare of the Institute, the Board proceed to notice the plan for extending the accommodations. The property of the masonic corporation, in Chesnut street, has been regularly transferred to the Franklin Institute. It has not been deemed prudent, under existing difficulties among mechanics, to go into the erection of a new hall upon this site at the present time. In the meanwhile, the committee who have charge of the property, will use it to the best advantage for the institution. The members should come forward liberally, to the full extent of each one's means and influence, to patronize the attempt to extend the usefulness of the Franklin Institute, by furnishing enlarged accommodations for its lectures, its schools, its library and reading rooms, its cabinets of models and minerals, and its exhibitions.

The contribution to practical science made during the past quarter, in the report of the Committee on the Explosions of Steam-Boilers, has been one of great importance, and may well excite the pride of the members. Public opinion will, it is hoped, be borne along with the final report of this committee, in their recommendations for preventing, or lessening, these disastrous accidents. For that report, the managers look with great interest.

The Committee on Science and the Arts have continued their useful labours in the examination of numerous inventions and improvements submitted to them. Their impartial decisions are, it is believed, highly esteemed by practical men. At their last annual meeting, the committee re-elected Professor A. D. Bache, Chairman for the ensuing year.

The new plan adopted for the Journal of the Institute, has met with considerable success. The same amount of matter on mechanics as formerly, is afforded, and, in addition, original and selected articles on Physical Science are admitted. The Managers again call the attention of the members to the fact, that their patronage of the Journal is by no means what it ought to be. Let no working man plead that he has not time to be a reading man. In the very important part which mechanics have to sustain, they must keep pace with the progress of mechanical science, or they will fall behind in estimation as a class. The Mechanics' Register, attached to the Journal, is not *heavy* reading, and, when more solid articles tire, cannot fail to amuse, as well as to instruct. The Editor, and the Committee on Publications, deserve and receive the thanks of the Board, for their united labours in behalf of the Journal.

The library has increased during the past quarter, by forty-five volumes on useful subjects. The cabinets of models and minerals have received a few additions. When there shall be more room to display their stores, it is hoped and believed that additions to them will be more frequent.

The number of members is increasing steadily. Since the last report, seventeen members have been admitted, and three have resigned. Mr. William Mason, and Mr. Thomas Ryan, have become life members of the Institute.

Herewith is presented the quarterly report of the Treasurer.

M. W. BALDWIN, *Chairman*.

WILLIAM HAMILTON, *Actuary*.

## Mechanics' Register.

### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER, 1835.

*With Remarks and Exemplifications by the Editor.*

1. For improvements in *Manufacturing the Prussiates of Potash and Soda, and in dying therewith, and with certain other materials*; Felix Fossard, city of Philadelphia; an alien, who has resided two years in the United States; November 7.

Mr. Fossard obtained a patent for a purpose similar to the foregoing, on the 14th of December, 1832, and a second on the 3d of April, 1834; and in his present specification he has recapitulated parts of the former for the purpose of making more fully known the improvements which he has since made, which consist, mainly, in the "process of dying blue by the double decomposition of a soluble ferro-cyanate, or prussiate, and a salt of iron, or other metal," by processes which he sets forth, but which are not of a nature to admit of being epitomized, or presented at all in a form which would interest any one not immediately concerned in, and chemically acquainted with, dying processes.

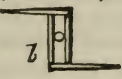
2. For a *Machine for Cutting Straw, &c.*; Henry C. Jones, Salem, Warren county, Ohio, November 7.

There is nothing in this cutting machine to distinguish it from a score or two of others, and of this the patentee seems to be aware, as he says that "this machine is operated somewhat similar to other straw cutting machines;" after which he proceeds to claim certain things which are of little or no importance, and some of them, withal, not new.

3. For a *Conical Arch Charcoal Burner*; Ezra B. Gilbert, Ephratah, Montgomery county, New York, November 7.

The claim made is to the before described conical arch charcoal burner, for manufacturing charcoal. Excepting in shape, we do not see in what particular this kiln differs from that patented by Mr. Doolittle, in 1829, and described by him in the seventeenth volume of Silliman's Journal, p. 396. We have long had by us a model of a charcoal kiln, exactly in the shape of that now patented. The person who sent it proposed obtaining a patent, but declined doing so when informed that there was not any thing new in the principle of it, or in his mode of application.

4. For an improvement in the *Horse Rake*; James Pudney, Stanford, Delaware county, New York, November 7.

Two bars, each about seven feet long, are to have rake teeth fixed into them, at suitable distances apart, and about two feet long. These two bars are to be framed together by timbers at their ends, so that the two bars may be about two and a half, or three, feet apart. The teeth are to point in opposite directions, thus,  where *a a* shows the points of the teeth, *a* and *b*, the timbers framed together. When the rake is drawn forward, one set of points is on the ground, the others serving as handles, by

which to guide it. When the rake is full, the upper ones are pushed forward by the person who guides it, and the rake rolls over, depositing the straw, grain, &c. The horse is geared to a frame, allowing of this rolling over, which frame is attached to the rake by headed pins, that pass through a slot in the timbers, *b*, which are double.

The claim is to the manner of using two heads, or rakes, and the self-adjusting slide, or groove, as the ends of the head bars.

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5. For a *Machine for Making Crackers*; Levin P. Clark, Baltimore, Maryland, November 7.

So far as we can judge from the description and drawing, this machine must be less efficient than some which have been previously patented and described; although the drawing is generally well executed, we cannot see how some portion of the operations described are to be effected, and cannot, therefore, make them known to others. The combination and arrangement are claimed, as is, *particularly*, a roller for turning the dough on to the moulds, &c.

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6. For a *Machine for Cutting Straw*; Ashman Hall, Kent, Putnam county, New York, November 7.

There is to be an angular knife, something like an inverted V, and this forms one of the claims; a claim is made, also, to a board, which is to gauge the length of the straw, and, lastly, to a spring to raise the sliding board; the angular knife is not new, and boards for gauging have been often used in a similar way.

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7. For a *Grist Mill*; Phillip Hauser, Cincinnati, Ohio. An alien, who has resided two years in the United States; November 7.

The grinding part of this mill consists of a common conical shell and nut, like those of the ordinary coffee-mill, without a single feature of novelty either in form or substance. The claim is to "the general arrangement and combination, but not to the parts, taken separately." It is one among those gross pretensions at invention which would excite much surprise, were they a little more rare.

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8. For a *Rotary Steam Engine*; John G. Hotchkiss, New Haven, New Haven county, Connecticut, November 7.

Abortive attempts at constructing rotary steam engines have been nearly as numerous as the attempts themselves; some of them, however, have evinced a great degree of skill, although unsuccessfully applied; but in the machine which forms the subject of the present patent, we do not perceive much waste of talent, nor any thing likely to disappoint any reasonable expectations. The whole scheme, in fact, is one which evinces an entire absence of elementary knowledge, on the subject of steam in particular, and of mechanics in general.

Steam is to be admitted through a hollow shaft into a revolving metallic drum fixed upon it; this drum has slots, or openings, on its periphery, through which the steam is to escape, and to strike against what are called "buckets," on the inside of a circular rim, by which it is surrounded, and which it nearly touches; the so called buckets are represented as grooves crossing the hollow rim, and formed like saw-teeth. This hollow rim has also slots, or openings, to allow the steam to pass through, and act upon a

second rim similarly constructed. Circular heads are to enclose the whole, excepting the last hollow rim, from which the steam may escape at the ends of each bucket.

"The principle of this improvement consists in the combination and arrangement of the steam wheels aforesaid, operating together in alternate opposite directions, by the direct and reacting force of the steam, as aforesaid."

9. For a *Smut Machine*; John Tuck, Columbus, Pennsylvania, November 7.

There is a stationary cylinder of sheet-iron standing on a suitable frame, its axis being inclined at an angle of about ten degrees with the horizon. Within this cylinder there is a second, which is made to revolve, the two being about three-fourths of an inch apart. They are both punched, grater fashion, their rough surfaces being towards each other. Within the inner cylinder there is a revolving fan wheel, extending its whole length. The grain is fed in at the upper end, between the two cylinders; the revolving of the inner one rubs the grain, whilst the wind from the fan, blowing through the apertures, discharges it, together with the cheat and cockle, the openings in the outer cylinder being made large enough for that purpose. The claim is to the machine generally, and "particularly to the shaft and spirally arranged wings for causing a current of air within the revolving drum."

10. For improvements in the *Art of, and Apparatus for, the transportation of Goods upon Canals and Rail-roads*; John Elgar, Civil Engineer, Baltimore, Maryland, November 7. (See specification.)

11. For *Canal Boats, to be propelled by steam*; John Elgar, Civil Engineer, Baltimore, Maryland, November 7.

A twin boat is to be made, the outer sides of each being vertical planes, parallel to each other. If an ordinary keel boat be supposed to be cut through the middle vertically and longitudinally, and the convex sides be then placed opposite to each other, leaving a space between them for a paddle wheel, the proposed form will be understood. It is supposed that such a construction will prevent the washing of canal banks. The claim is to "the straight external sides, with curved internal sides, of a twin steam-boat, to be used on canals, and elsewhere."

There have been propositions and patents for similar boats, but we do not know of any now in use, nor do we believe that they will present the anticipated advantage. The water way between the boats becomes less and less as the greatest convexity of the two parts is approached, which causes the water to *pack*, and rise in front, which will occasion, we apprehend, nearly, or quite, as much swell as a boat of the ordinary form, and, at the same time, create a resistance which will consume a part of the power applied.

12. For *Counter Scales*; Elias A. Hibbard, Lunenburg, Essex county, Vermont, November 7.

A beam is made, one end of which is graduated like that of the steel-yard, and the other supports a scoop, or scale, into which are put the articles to be weighed. The beam has a cross-bar, forming its fulcrum, and resting upon two uprights; below the scoop, or scale, there are suspending

links, with the necessary attachments for the scoop to rest on, and preserve the centre of gravity. The affair is imperfectly described, but the drawing shows the particular construction of the balance, which is certainly inferior to those imported counter scales, which have the weight above the beam, and which are now much used.

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13. For *Preparing Extracts of Bark for Tanning*; Otis Batchelder, Bedford, Hillsborough county, North Carolina, November 7.

The following is the recipe: "Put such quantity of the extract of the bark into the vat as may be required; then put upon the extract, vinegar, or some other acid, in the proportion of about two gallons of vinegar to the hundred weight of the extract; after that, put on water, cold or warm, in sufficient quantity to cover the extract; then pulverize and mix well, and then add such quantity of water as may be necessary, and the liquor is fit for use. What he claims as his improvement, is the method of dissolving in cold or warm water, with the addition of acid, instead of boiling, as has been heretofore done."

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14. For an improvement in the *Manufacturing of Horse Collars*; Henry C. Call, Sterling, Windham county, Connecticut, November 14.

This collar is, when finished, to be in the form of the most approved collars now in use; "the improvement consists in the process of cutting whole, and making without seam, or welt;" we are told, also, that "the pattern hereunto annexed is for the usual, or common, size;" but the drawing does not represent any such pattern, nor is any attempt at describing it made in the specification.

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15. For a *Revolving Screen for Cleaning Grain*; Edward P. Fitzpatrick, Mount Morris, Livingston county, New York. An alien, who has resided two years in the United States; November 14.

Instead of using woven wire, in meshes, as is usually done, this screen is to have wires running straight along it; of these there are to be several sections in the length of the screen, each section extending from one rim to another, which is fastened upon the axle for that purpose. The screen is to be inclined, and the grain fed in at the upper end, in the usual way; the wires in the first section are to be so close together as to allow only dust to pass; the next is to allow cheat to escape; the next small wheat, and the last large wheat. Between the two last it is proposed to form the cylinder of sheet metal, instead of wire, and to punch it full of smooth round holes, large enough for the discharge of cockle.

The claim is to the placing of rods, or wires, lengthwise of the cylinder, from one groove circle to the other, at suitable distances apart, for cleaning grain; instead of woven coverings, with numerous openings.

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16. For an *Anti-friction Box for the Hubs of Carriages*; Eyra Fisk and Joseph C. Green, Fayette, Kennebec county, Maine, November 14.

This anti-friction box is a modification of Garnett's friction rollers, of which we have had occasion to make frequent mention, as a similar contrivance has been repeatedly made the subject of a patent. In our notices of these contrivances we have never seen cause to commend them, especially when intended to be applied to carriage wheels, nor do we believe that they have in any instance, been really what they purported to be, improve

ments upon Garnett's; and as to the plan now before us, we think it very inferior to the original arrangement.

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17. For a *Centrifugal Pneumatic Steam-Engine*; Charles J. Conway, city of New York; an alien, who has resided two years in the United States; November 14.

A very elaborate description of this engine is given, and the advantages expected to be derived from its use are fully set forth, but no claim whatever is made to any part of it; but we are not of opinion that this omission would have any tendency to vitiate the patent, as the general arrangement appears to be new. We are well convinced, however, that this is its only merit, and that we are not likely ever to see it in action, unless some accident should throw us in the way of its first trial, should not that have been already made.

The furnace is to be a revolving tube, surrounded by a case supplied with water for generating steam; this steam, and the gas from the fire are to rush out together tangentially from the periphery of a revolving drum, with a force which is to possess immense power. The fuel is to be supplied through the hollow axle on which the machine revolves, and is to be thrown into the furnace by centrifugal force. The averments of the specification contravene the known laws of mechanical and of chemical philosophy in more than one instance.

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18. For *Cisterns, Reservoirs, &c. of Hydraulic Cement*; Levi Kidder, city of New York, November 14.

A pit is to be dug, of a circular form, and the bottom of it is to be covered with hydraulic cement, say to the depth of six inches; upon this floor is to be laid a cylindrical mould, allowing sufficient space between it and the earth for the thickness of the intended side wall, which space is to be filled in with hydraulic cement; another cylindrical section is then to be placed on the former, and the process repeated until the wall is of the required height. To counteract the external pressure from water in the soil, the cistern may be supplied with water from any convenient source, as the work proceeds. The claim is to the foregoing process; a claim which can be as well sustained as most of those previously set forth in patents for making cisterns of hydraulic cement; but no better.

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19. For *Anodyne Alterative Syrup*; Rezin Thompson, Rome, Smith county, Tennessee, November 14.

Take 2 oz. extract of henbane,  
14 oz. extract of walnut, or butternut,  
2 oz. essence of sassafras, and  
1 gal. simple sirop.

Dose for an adult, half a table spoonful, &c.

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20. For *Raising Vessels from the Water for the purpose of Repair*; Rufus Porter, Bellerica, Middlesex county, Massachusetts, November 14. (See specification.)

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21. For an improvement in the *Smut Machine*; Edward B. Fitzpatrick, Mount Morris, Livingston county, New York, November 14.

This smut machine is to consist of an outer stationary cylinder, standing

vertically, its periphery being formed of longitudinal rods or wires, placed so close together that grain will not pass between them, whilst the dust from the smut will escape readily. Within this there are to be revolving beaters formed by extending square iron rods from one set of cross arms on the lower end of a revolving shaft, within the cylinder, to other similar cross bars near the upper end of the shaft, and close within the heads of the cylinder; these rods are to be made ragged at their edges, and placed near together on the cross arms, extending from the shaft to the periphery of the cylinder. They are not to run directly along with the cylinder, but spirally, just as they would stand supposing them to be put in straight at first, and one of the sets of cross arms to be then turned half way round, thus giving a spiral direction to the rods.

The grain is to be fed in through the upper head of the cylinder, and to escape through an opening in the bottom head; but in passing down it is driven forcibly about by encountering the spiral beaters, the shaft of which revolves with great rapidity, and by this means, it is said, the smut is effectually removed.

The claim is to the above described manner of constructing a smut machine.

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22. For *Preparing and Using Elastic Japan for Leather*; William Gates, Hanover, Chataque county, New York, November 14.

The japan is to be prepared by boiling two quarts of linseed oil until the yellow scum disappears, then adding two ounces of umber, and one of litharge, and boiling again for an hour and a half; after this the dryers are to be allowed to settle, and the clear liquor poured off. Eight ounces of India rubber, in shreds, are to be heated in a vessel with two quarts of spirits of turpentine; to these are to be added the two quarts of boiled oil and the compound is to be kept at a boiling heat until the gum is completely dissolved, which may be six hours. Eight ounces of asphaltum are then to be added and dissolved. This constitutes the japan.

The second part of the process consists in laying the varnish on the leather, which is to be done by a brush or sponge, and in the rubbing down and slicking, which are minutely described. The claims made are to "the particular method of compounding the japan so as to make it elastic, and at the same time permit it to dry readily; and the manner of affixing it to the leather."

We do not see any thing in the manner of compounding the japan, which is new to us, either as respects the materials employed, or the mode of treating them; nor is the manipulation of laying it on, rubbing it down, slicking, &c. generally distinguished from the plans heretofore followed.

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23. For a *Fire-place and Cooking Stove*; Joshua Douglass, Durham, Cumberland county, Maine, November 14.

This stove does not require description, as we could not possibly distinguish it from numerous others; the claims are to the "fire-place and jointed damper, as combined with the cooking stove, in the manner described."

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24. For a *Truss of Gum Elastic*, for Inguinal Hernia; Varnum Wilkinson, city of New York, November 14.

The distinguishing feature of this truss is said to be the formation of it without the employment of metal or of wood, in any part of it; the pad also

being different in shape from others. The patentee says that he had used India rubber before Dr. Heintzelman obtained his patent for a pad of that material, but we could point to trusses where not only the pad, but the strap also was of India rubber, made some years prior to Heintzelman's patent, which latter was not for the material employed, but for the particular manner of using it. The present patentee has left his description so vague and general as to be very far indeed from fulfilling the requirements of the patent law.

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25. For a *Machine for Extracting Hair from Skins*; Nahum Swett, Readfield, Kennebec county, Maine, November 14.

The skin is to be placed upon a revolving cylinder, to which it is to be attached, by means described in the specification, but very inadequately represented in the drawing. An elastic roller, covered with India rubber, which is again covered with leather, is borne up by spiral springs against the revolving cylinder, and the hair is to be taken off by means of a knife, fixed for that purpose. The claims made are to the particular manner of constructing the cylinder, and of fastening the skin thereto; the mode of constructing the elastic roller, and the general arrangement of the several parts.

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26. For a *Truss for Hernia*; Robert Semple, Concordia Parish, State of Louisiana, November 14.

The general construction of this truss is that most commonly employed, the improvement claimed being in "the construction and material of the front pad;" which is to be formed of wood, and to be covered with thin sheet lead, or a composition of lead and zinc. This, it is said, makes a block, or pad, so light as to be easily retained in its place, whilst the polished surface of the metal prevents the abrasion of the skin.

Hard substances have been so long used for pads to trusses, that a claim to them simply, would be unavailing. One with a pad of solid lead has been the subject of a patent. Ivory has been used for at least forty years, and is as smooth and light as one of wood covered with metal; we really, therefore, cannot perceive any ground upon which the present claim is to be sustained.

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27. For *Propelling Boats by a Spiral Screw*; Edward P. Fitzpatrick, Mount Morris, Livingston county, New York, November 23.

The shaft of this screw is to swell in the middle, so as to resemble two cones united at their bases, and the spiral thread by which it is surrounded is also to be wider at the middle than at the ends; the so making this screw constitutes the whole claim. The spiral screw propeller has been so often patented, tried and condemned; that its history, if written, would be one of disappointed hopes, which might well serve as a beacon to future voyagers. We do not believe that it can ever be made to assume a form by which it will be rendered efficient, and most certainly that given to it by the present patentee will not, in the slightest degree, redeem its character.

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28. For a *Cheese Press*; William C. Greenleaf, Andover, Oxford county, Maine, November 23.

A follower is to be forced down by a toggle joint, the pressure being continued by hanging a weight to a lever, or arm, attached to the joint. The patentee says, "I do not claim the original invention of the toggle

joint, but I do claim as my invention its application to the purpose of pressing cheese." Independently of the toggle joint having been previously used for the purpose, such a claim we esteem as altogether worthless, for if a claim to the "application" is valid, there may be as many patents for one press as there are articles to be pressed. The law grants patents for any "new machine."

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29. For a *Spark Catcher*; George Holbrook, Boston, Massachusetts, November 23.

We do not perceive any essential difference between this spark catcher and some others which have been previously patented. The sparks are to be arrested by coverings of wire gauze, and are to fall into a tubular reservoir surrounding the chimney. The arrangement of the coverings is somewhat different from that of others, but not to an extent which changes its character. The claim made is to "the manner of constructing and applying the frames as set forth."

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30. For a *Machine for Dressing Feathers*; Bartholomew Smith, Schodack, Rensselaer county, New York, November 23.

A tub of sheet iron is to be made, which may be six or eight feet in diameter, and its bottom is to be perforated with numerous small holes. A vertical shaft, which is to be made to revolve by means of a wheel, rises from the centre of the tub, and carries a number of curved whippers, or beaters, which are to act upon the feathers. A covering of sheet iron, or of any other suitable material, say of cotton ticking, is to rise above the tub, and to surround the beaters and feathers. Under the middle of the tub there is to be a small furnace for heating the feathers, the heat being confined, and reflected under the tub by a tin vessel, or casing. It does not appear that water or steam are to be in any way employed in the process. There is not any claim made, and the only difference which we see between this machine and others is in shape; to some of them it is certainly inferior, being less convenient, and neglecting an agent, steam, which is very advantageously employed in dressing feathers.

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31. For *Administering Medicine by Steam*; Benjamin Grut, city of New York, November 23.

Steam is to be conducted through certain herbs placed upon a strainer in a tin vessel, the vapour being led to the place desired through a tube in the top of the vessel.

"It is the method of disengaging and applying the medicinal virtues of plants, herbs, and roots, to a local part of the body, for which I claim a patent as my own invention, and not previously known."

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32. For a *Bedstead and Mattress combined*; Edmund Cherrington, Boston, Massachusetts, November 23.

Instead of the sacking bottom usually employed, tubes of metal, with worm springs and steel plates, are to support the mattress. The posts and rails are to be put together by dove-tail fastenings, which, if they differ from those formerly used, are not clearly explained. The claims made are to "the steel plates attached to the worm springs in the metal tubes, and the manner of applying the same; and the manner of putting the bedstead and mattress together, and fastening them with a dove-tail and button." The

manner of applying the steel springs, &c. is the same as in the next article, to which, therefore, we refer.

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33. For a *Spring to be used in Sofas, Chairs, &c.* Edmund Cherrington, Boston, Massachusetts, November 23.

We insert the whole description. "Two worm springs are enclosed in brass, or other metal, tubes; a steel plate of the length required, is attached to the hooks on the ends of the worm springs, and extends from the one to the other."

"What I claim as my invention, and not previously known, is attaching the steel spring as aforesaid, and applying it to the purposes above described."

Spiral steel springs are to be enclosed in tubes, like those of spiral spring weighing machines, and rows of these are to be placed along each side of the frame of the sofa seat, (or bedstead;) to these are hooked thin metal straps extending from side to side, like strained girths, and upon them the mattress. in the former patent, and the sofa seat in the present, are to rest.

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34. For improvements in the *Constructing of Rail Roads*; Elisha Johnson, Civil Engineer, Rochester, Monroe county, New York, November 23.

The patentee of the improvements which are described is, it appears, the Chief Engineer of the Towanda Rail Road, commencing at the city of Rochester, in the state of New York. The object proposed is to save a very large portion of the labour and cost in filling up when there are to be embankments. The whole description, with the accompanying observations occupy considerable space, and all that we can do, at present, is to give a general idea of the mode of procedure.

In passing through a well timbered district, where embankments are to be made, a road is constructed by fixing vertical blocks, or posts, of rough timber, squared at the ends; these may be 18 inches in diameter, and be placed ten feet apart, lengthwise of the road; upon them are to be placed round cross timbers, 12 feet in diameter and 9 in length; these, of course, being spotted to fit on to the uprights. Longitudinal pieces of round timber, not less than a foot in diameter, are to be hewn flat at top, and squared at the ends, in lengths of ten feet. Hard string pieces, 2 by 4 inches, are to be spiked on to the longitudinal pieces, and upon them the cars are to run. "The framed earth boxes are of a new and particular form, adapted to the purpose of completing the excavation and embankments; they are to have four, six, or eight wheels. Those with eight wheels have four earth boxes, one at each end, to dump endwise, and two in the middle, to dump at the sides.

The embankments are to be made by filling in along this temporary rail road, and it is to be continued in use until there has been a perfect settling of the earth, serving during this period, all the purposes of transportation; after which the permanent rails are to be laid in the usual manner.

The claims made are to the application of such rough timber as is at hand, in the way described. The use thereof for the purpose of embanking, and for transportation during the settling of the earth. The extending of the road into and through swamps and prairies; and the covering the whole of the timber with earth, excepting the ribbons on which the iron plates are spiked.

A large part of the specification is devoted to a display of the advantages

which are to result from the mode of procedure adopted; the means, however, by which results are attained, are the only things patentable. How much of the plan proposed is to be considered as new, is left to the judgment of those informed in the history of the construction of rail roads; we will remark, however, that we do not find any thing set forth in that clear and discriminating manner which is requisite to secure it under a patent.

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35. For *Machinery for Making Horse Shoes*; Henry Burden, Troy, Rensselaer county, New York, November 23.

The specification of this patent refers to three sheets of drawing, representing the machinery very clearly; it must be manifest, therefore, that we cannot here attempt a description of it in words. The machine is evidently constructed by one possessing much skill and knowledge in mechanics; and all the accounts we have heard of its performance, concur in representing it as effecting the intended purpose in a very perfect manner.

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36. For a *Spring Saddle*; Adam Hickman, Abington, Washington county, Virginia, November 23.

The claim made is to a "spring, which is attached to the hind plating of the tree, thence running to the under part of the cantle, and working on brass or steel plates, fastened to the under part of the cantle;" "which spring gives the cantle and steel bars an action similar to the operation of a bellows, the saddle itself being drawn over the steel bars."

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37. For a *Marine Hoisting Apparatus*; John C. Campbell, and Increase S. Withington, Boston, Massachusetts, November 26.

This apparatus, we are informed, is intended to raise sunken vessels; to float stranded vessels off shore; to carry vessels over shoals; and to raise them out of the water for repair.

"These objects are effected by sinking hollow boats, or casks, filled with water, and attached to the object to be raised, and then expelling the water by a forcing pump from the boats, or casks, and supplying its place with air."

The manner in which this may be done is described, presenting nothing new in principle, or in practice, but exhibiting the application of a mode of raising vessels which has been more frequently resorted to than any other, and that from time immemorial. The patentees, however, limit themselves to the particular construction of the apparatus described, their claim being to "the machine, or apparatus, herein described, as combined together for the purposes before mentioned."

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38. For an improvement in *Steam Boilers*; Thomas Ashcroft, Machinist, Boston, Massachusetts. An alien, who has resided two years in the United States; November 26.

This is a complex apparatus, consisting of a main vertical cylindrical boiler, surrounded by six, or any other convenient number of small boilers, each of which is to have its separate furnace. The main boiler may be a cylinder of thirteen feet in height, and two in diameter, closed at top, and at bottom. A casing round this boiler, and distant from it about three or four inches, extends up to the top of the main boiler, and is open for the escape of smoke, &c. Another case surrounds this, and is called the *steam*

passage; this is closed both at bottom and top, but communicates, by means of tubes, with the main boiler.

The six surrounding boilers are to be upright, and about three feet in height, their bottoms being about even with that of the main boiler; they consist of water compartments, surrounding the furnace, and receive their supply from the main boiler exclusively. The steam from each of them passes, through tubes, into the steam passage, and then into the main boiler.

The claim is to "the combination of boilers and apparatus before described, by which one main boiler of greater height, and less exposed to the heat, is enabled to supply water to one or more smaller boilers, which are more exposed to the heat, for the purpose of keeping them constantly full by the pressure of the column of water in the main boiler."

We cannot concur with the patentee in the idea that such a boiler can be made at less cost than one of the ordinary construction; great difficulty must be encountered in it, from the incrustation which will take place within the smaller boilers, but the anticipated circulation of the water will, it is calculated, prevent this, an effect to which we do not believe that it will be equal.

39. For *Chilling the Interior Surfaces of Cast-iron Cylinders*; Henry Saunders, Dobb's Ferry, West Chester county, New York, November 7.

Conical boxes have been chilled on their inner surfaces by casting them upon solid metal cores, which are driven out whilst the iron is yet hot; but cylindrical metal cores cannot be thus removed. The present patent is taken for so constructing cylindrical metal cores, that they can be readily removed, leaving the cast cylinders smooth, true, and hard, on the interior.

To effect this object, the cores are to be divided, longitudinally, into two, three, or more, pieces, and these are to be kept together by collars passing over projections on their ends, for that purpose; conical wedges, or pins, are used to keep the pieces properly extended, by driving them into openings in the ends of the core. Those persons who have noticed the manner in which hat blocks are divided, to remove them from hats with enlarged crowns, will at once understand the principle adopted in the present case. The claim is to "all iron castings, of whatever form, size, or kind, having cylindrical interior faces, and which shall be chilled upon iron, or other metallic pins, composed of two or more parts, and divided longitudinally."

40. For a *Mortising Machine*; John M'Bride, Richmond, Wayne county, Indiana, November 26.

In this machine, the chisel is made to advance upon the piece to be mortised, instead of causing the piece to move under the chisel. The chisel is to be acted upon by two compound levers, one of which is to be moved up and down by the hand. The fulcrum of the lever to which the chisel is attached, is on a kind of slide, which is caused to progress forward by a pall falling into a rack. The precise way in which this is effected is not clearly shown, and, indeed, there is considerable obscurity in the description of the machine in general, so that a workman could not undertake to make it from the information furnished. The claims would not serve to convey any definite idea of the things which are the subjects of them.

41. For *Turnabouts, or Platforms, for turning rail-road cars*; David Evans, Penn township, Philadelphia county, Pennsylvania, November 26.

This platform is to have conical rollers, by which it is to be sustained; arms extending from the centre, under the platform, upon which they are to revolve; and there is also to be a safety lever for arresting the platform, when it has arrived in the proper position.

The claims are to "the *conical balls*, with holes, or axles, and the guidance of them by the main centre, by means of the bars extending therefrom to the hoop on the outer circumference; and the self-tending safety lever, for regulating, or stopping, this, or any other, platform."

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42. For a *Sheet-iron Boat for Navigating Canals*; Leeman Parmelee, Poughkeepsie, Dutchess county, New York, November 26.

This patent is taken for making a twin boat of sheet-iron, as will be seen by the claim to invention, which "consists in the *sheet-iron twin boat*, for navigating canals by steam, or horse, power." There is not any thing peculiar in the formation of the boats, nor is there any thing new in making canal boats of sheet-iron; the invention consists, therefore, in putting two such boats together, exactly in the way in which twin boats of wood have been united.

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43. For a *Spring Saddle*; Charles Bates, Staunton, Augusta county, Virginia, November 26.

The spring of this saddle is exactly similar to such as have been made the subjects of two or three recent patents, from the same State, the principal change being the employment of two zig-zag springs, instead of one, and the fixing them somewhat differently in the iron frame within which they act.

The patentee says, "I do not claim the form of the zig-zag spring and frame; but what I do claim as my invention, is the peculiar mode of arranging and securing *two* springs to the movable bar, as above described."

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44. For an improvement on *Tub Water Wheels*; Edward Newnam, Hendricks county, Indiana, November 26.

This is a poor contrivance, poorly described, and as poorly represented. The design, however, appears to be to double the power of the water, by letting it on at opposite sides of the wheel. The affair is without a claim, and is not worth one.

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45. For an improvement in the construction of *Crucibles, Stove Cylinders, Grate Backs, &c.*; John Scott, city of Philadelphia, November 26.

This improvement consists "*in the use and application* of the inconsumable substance, *asbestos*, in the construction of crucibles," &c., "as follows. Let the asbestos be mixed with mineral substances, pulverized and moistened so as to form a thick clay, such as isinglass, soap-stone, black lead, and fire clay; and then let the mass be hardened by the action of heat, or by gradual drying."

The whole of the foregoing proceeds under the mistaken notion that asbestos had not been before used as a component part of the linings of furnaces, and the formation of other articles which are to bear high degrees of

heat. We have used, and seen it used, for such purposes, in numerous instances, and there is no experimental or operative chemist to whom the use of this material would be a novelty, and who would not have employed it, when at hand, without claiming to have made any discovery. "In Corsica it is advantageously used in the manufacture of pottery, being reduced to fine filaments, and kneaded up with the clay; the effect of which is to render the vessels less liable to break, from sudden alternations of heat and cold, than common pottery." Article, ASBESTUS, *Encyclopedia Americana*. This is the first authority to which we turned, but numerous others might readily be cited.

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46. For *Sheet-iron Fire Frames*; Gilbert Richards, Ashfield, Franklin county, Massachusetts, November 26.

The whole *invention* consists in making the sides, top, and front plate, of a Franklin stove, of sheet, instead of cast-iron, and the so doing constitutes the claim.

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47. For *Hulling and Cleaning Cotton, and other, Seeds*; John Ambler, Jr., city of Philadelphia, November 26. (See specification.)

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48. For an improvement in the *Hydrant*; Sater F. Walker, city of Baltimore, November 26.

The claim under this patent is to "the mode described of constructing and using the ascending tube, so as to discharge the waste water at pleasure, either above or below the surface of the ground; the mode of preserving the distance between the valve seat and screwed nut at the top; and the making a waste cock of metal with a wooden key, and leather interposed." It would require considerable space to explain the arrangements referred to, and as we understand that Mr. Walker is about to apply for a new patent for certain modifications of his apparatus, we shall wait until these come under our notice.

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49. For an improvement in *Grist Mills*; Samuel Hyde, Malone, Franklin county, New York, November 30.

This appears to be intended for a portable mill, although no dimensions are given. Both stones are to revolve in the same direction, the lower with a slow, the upper with a rapid motion. The lower stone is fixed upon a hollow shaft, and the upper upon a spindle which passes through it. The shaft of the lower stone runs upon "bead rollers," that is, upon round balls retained in a groove. The gearing we shall not attempt to describe, as this might be varied by any competent workman. The running both stones in the same direction, with different velocities, is claimed, and, for aught we know, this claim may be sustained; but we are uninformed respecting, and cannot perceive, any advantage which can result from this construction, whilst it is open to the objection of complexity. The "bead rollers," at the bottom of the exterior shaft, are claimed, but they have repeatedly been applied to shafts, although soon abandoned, as they are theoretically and practically bad.

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50. For an instrument for *Cutting Wood*; John Ruthven, city of New York. An alien, who has declared his intention to become a citizen; November 30.

This instrument is to be used as a substitute for mill, cross-cut, circular, and other saws. The cutting part consists of two steel edges, which are to operate like a paring chisel, taking off a narrow shaving, instead of tearing the wood by numerous points. A mortise is to be made on the edge of a blade, such a blade, for example, as would be fixed in a frame, in the place of a mill saw; and into this the cutters are to be secured, one edge pointed in either direction, so that the cutting may be effected both by the up and down strokes, the feed of the log, in this case, taking place at the termination of each stroke. In the circular saw, the cutters will, of course, all stand in the same direction, and the feed, we suppose, will be continuous.

When used for cross cutting, there are to be additional lateral cutters, to cut across the grain, like the fore iron in a cut-and-thrust, or a plane for cutting grooves across boards.

The claim made is to "the instruments described, and the method of cutting wood by them."

We very much doubt the general applicability of this method of cutting wood, instead of sawing it; a good mill saw may be fed half an inch at each stroke, whilst cutters, such as those described, cannot be allowed to cut more than an eighth of an inch, making a quarter in the double stroke. There will be a difficulty, also, in holding down the log in the up stroke, and the stuff will *spole* when the cutters arrive at the edges of the boards. The kerf, also, we apprehend, must be made thicker than with a good saw. The cross cutting appears to present other objections, which, with those already enumerated, we shall be glad to hear have been practically dissipated.

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51. For a *Spark Catcher*; James W. Waples, Wilmington, New Castle county, Delaware, November 30.

This spark catcher is to turn, like a vane, at the top of the chimney, a shaft passing up from the centre to sustain, and allow it to revolve. The part immediately over the chimney is covered with wire gauze, forming a segment of a hollow globe, but the whole is extended out on one side, so that the bottom of the spark catcher may be in the form of a long oval, the extended part being called the receiver; the covering of wire gauze is common to the whole, but that part in front, or rather to windward, is coarser than usual, to admit air the more freely, the other end, or receiver, acting as a vane, and keeping the whole in the proper direction. The two parts are united by a hinge at top, allowing the receiver to be turned up, to discharge the sparks, ashes, &c., when they have accumulated.

The claim is to "the before described spark catcher and receiver, and the mode of cleaning the receiver."

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52. For a *Reel to receive Water-proof Cloth as it is coated with the composition*; John Goulding and Reuben Brackett, Boston, Massachusetts, November 30.

The reel is to receive the cloth after it passes the reservoir by which one of its surfaces is covered with the composition, and is so constructed that the successive portions are kept from contact with those which preceded it. It consists of an axis, turning on gudgeons, and having at each end, within the uprights, six or any other preferred number of arms, standing at right angles thereto. These arms are notched on their edges, at regular distances, to receive the ends of rods, or cross bars, extending from one

to the other. The end of the cloth being properly secured, near the axle, the rods, as the reel is turned, are successively put into their places, and the sides of the cloth are thus kept separate, the whole forming a sort of hexagonal spiral.

The claim is to "winding cloth covered with dissolved India rubber, or water-proof composition, on a reel, at the time of coating, or after the operation of coating has been completed."

The circular tenter bars, described at page 19, vol. XVI, are an analogous contrivance, but not adapted by the arrangement of its parts, to the purpose to which the present reel is applied.

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53. For a *Diving Dress*; John Read Campbell, Boston, Massachusetts, November 30.

This is said to be an improvement on the diving suit patented by Nathaniel Wolcott, on the 17th of April, 1834, which has been assigned to the present patentee. One notice of that patent may be seen at page 330, vol. XIV. The improvements proposed are the making the cap, or case, for the head, entirely of glass, to increase the field of vision, and the encircling the body by a metallic case, under the India rubber cloth, to prevent compression. The philosophy of some of the appendages described, we do not comprehend, nor can we discover that any of the ordinary difficulties in the use of such dresses are more completely obviated than by previous contrivances.

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54. For a *Kiln for Drying Grain*; Thomas Crook, New Hope, Bucks county, Pennsylvania, November 30.

This patent is taken for an improvement upon a kiln for the same purpose, patented by Benjamin Parry, in the year 1810. In this kiln, it appears that the grain was fed into an inclined pan, contained in a chamber heated by a furnace and flues, the pan being agitated by a roller to cause the grain to descend regularly along it. The present patentee uses two pans, one above the other, and inclined in reverse directions, the grain falling from the first into the second; he suspends his pans by chains, and agitates them by a roller in a more convenient manner than heretofore. The claims made are to "the manner of arranging a second pan under the first, for the purpose described. The manner of strengthening the pans, as above, and the method of supporting them at the outside, by swing chains, instead of a roller."

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55. For a *Hot Air Forge Hearth*; Richard Walker and Leonidas V. Badger, Portsmouth, Rockingham county, New Hampshire, November 30.

A box is to be made which consists of two parts, standing at right angles to each other; one of these constitutes the back, and the other the bottom of the forge. Each of the parts may be a foot square, and two and a half, or three inches deep. The air is blown in in the usual way, and traverses back and forth several times, between partitions, before it arrives at the tuyere. The claim is to "passing the wind under and back of the fire, making a complete hot air blast." At least one-half of this claim is invalid, as the air has already been heated by a similar box at the backs of forges, if not under them.

56. For a Machine for *Cutting Straw*; John Wirt, Evansham, Wythe county, Virginia, November 30.

The whole of this apparatus is confessedly old, with the exception of "a cog wheel on the shaft of the cutting and fly wheel, working in the teeth of the crown wheel, on the end of the lower feeding roller, for feeding the machine." The same purpose has been effected by similar means, and that forty years since.

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#### SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a Patent for Improvements in the Art of, and Apparatus for, the Transportation of Goods upon Canals and Rail Roads. Granted to JOHN ELGAR, Civil Engineer, Baltimore, Maryland, November 7th, 1835.*

To all whom it may concern, be it known, that I, John Elgar, of the city of Baltimore, in the state of Maryland, have invented certain improvements in the art of, and in the apparatus for, the conveyance or transportation of goods, on a line where canals and rail roads form alternate links in the chain of communication, as for example, on the great Pennsylvania line from Philadelphia to Pittsburg; a part of which invention, or improvement, may be applied to the construction of, and transportation in canal boats, on those lines in which the mode of conveyance is by water alone; and I do hereby declare that the following is a full and exact description of my said improvement, or invention.

The object which I have in view in the first instance, is to prevent the necessity of removing the goods from the vehicle within which they are first loaded, by constructing cases which serve on rail roads as car bodies, and on canals as boats. This I effect by making such vehicles, or car bodies, of sheet iron, in the manner of iron tanks, riveting them up water-tight in the same way. The dimensions of these bodies must be determined by that of the canal locks, through which they are to pass when used as boats. If, for example, the lock will admit a boat of fourteen feet in width, and eighty in length, the bodies may be made seven feet wide and twenty feet long, so that eight bodies, two abreast, and four in length, may pass at the same time. I intend sometimes to make the bodies wholly of sheet iron, but they may be made of that material to the height of about three feet only, with an additional height, say of three feet, made of wood. The bodies when made of this length are to be carried upon eight-wheeled cars. If four-wheeled cars are preferred, the bodies must be made of a length suitable thereto, and a greater number of them will then, of course, be connected together, when in the water.

As these bodies are, by their combination, to form canal boats, the requisite number of them are to be so formed at one end as to constitute a well shaped bow, and the same number are to be so shaped as to constitute a stern; the other ends are to be made square, so that when connected by proper fastenings they will be in one continuous inflexible line, to the length of the lock through which they are to pass.

It is a well known fact that the resistance to a boat moving through the water, is nearly as the cross section of the part immersed, without regard to length; and I contemplate the obtaining a great advantage from the application of this principle in the conversion of my car bodies into canal boats,

as they are to be made but half the width of an ordinary boat, their draught being the same, their cross section will be but one half; I contemplate, therefore, the coupling of these bodies together in one continuous line, without placing them side by side, excepting when they are passing through locks, by which means but one half the power of traction ordinarily required will be found necessary, the foremost and the hindmost bodies constituting a stem and stern.

The great length given to the combined boat in this case, will render it necessary to make provision for passing along those parts of the canal where there is any considerable curvature. For this purpose I construct a certain number of the bodies in such a manner as that when coupled so as to constitute a canal boat, they will form a rule joint, which will allow of the requisite lateral motion to conform them to the curvature of the canal. To make such a joint, the end of one of the bodies composing it must terminate in the concave arc of a semicircle, and that of the corresponding one in a convex semicircle, adapted to each other. The distance apart of these flexible joints should be equal to that of an ordinary canal boat, so that when detached they will pass side by side through the locks.

These rule joint sections are to be coupled together by a connecting bar which falls, or is placed, on a strong upright pin, fixed in the centre of the circumference of the joint, or in any other convenient mode.

To cause the boats so connected to conform to the curvature of the canal, and to steer them by making one act as a rudder to the other, I fix a wheel and pinion, or adapt a lever, or other power, at each rule joint, so as to communicate the requisite degree of flexure. A compound boat of any desired length may thus be formed and managed, the first of the series of sections, only, being bow formed, and the last, only, stern-formed.

The bodies may be transferred from the cars to the water, and from the water to the cars, by means of powerful cranes; but the mode which I intend in general to adopt, is to extend the rail way down into the canal basin, in the manner practised in marine rail ways; the bodies may thus be made to float from, and on to the cars, with the utmost facility.

The rule joint, and mode of steering, I also intend to apply to canal boats of the ordinary construction and length, but reduced in breadth one half, so that in passing through locks the boats may be disconnected at the joints, and pass through in pairs, side by side, thus obtaining the advantage before alluded to as resulting from the diminution of the cross section, and admitting of an increased velocity with a decreased injury to the banks of the canal.

What I claim as my invention in the within described art of, and apparatus for the conveyance or transportation of goods on lines of canal and rail road, is the constructing of car bodies in the manner set forth, so that they may be converted into canal boats, upon the principle, and for the purposes herein fully described and specified. I also claim the connecting of such, or other canal boats, by rule joints, for the purpose of adapting them to the curvature of the canal, and of steering them by their action upon each other, upon the same principle with that by which a rudder is made to steer an ordinary boat.

JOHN ELGAR.

*Specification of a Patent for an Apparatus, and Mode of Using the same, for Raising Vessels for the purpose of Repair. Granted to RUFUS PORTER, Bellerica, Middlesex county, Massachusetts, November 14th, 1835.*

Four square timbers, eighty feet in length, are placed parallel to each other, and so arranged that the space between each pair is ten feet, and the whole breadth across the four is forty-feet. Across these are placed, at equal distances, seventeen other timbers, forty feet long, being firmly secured to the first four by tree-nails, and over these last is placed a strong plank floor; the whole constituting a stage, or platform, eighty feet in length, and forty in breadth. This platform rests on four square trunks, each being thirty feet long, ten feet wide, and ten feet deep. These trunks are constructed of framed timbers and plank, and are closed and made water tight on all-sides, except an open space of ten feet in length, by four in breadth, in the centre of the bottom of each, and are placed under the four corners of the platform, between the long timbers above mentioned, so that only the cross timbers rest on the tops of the trunks. The platform is further supported by braces extending diagonally from the sides to the trunks, and also connected by iron rods crossing from one to the other. The platform and trunks, which thus connected I call the elevator, being put into the water, or rather having been constructed afloat, a sufficient quantity of stone is placed on the iron rods to cause the whole to sink when filled with water.

Two scows, each eighty feet long, and eight feet wide, are kept in attendance, one of which floats over each side of the elevator; and ropes being attached to the four corners of the elevator, or to arms projecting therefrom, are also made fast to the bow and stern of each scow, thus preventing the elevator from sinking below a certain depth, say twelve feet below the surface of the water. Each scow contains, besides a small steam engine, of one horse power, two hollow cylinders similar to the cylindrical boilers of high pressure engines, each cylinder being thirty feet long, and thirty inches in diameter. From each of the four cylinders a piece of leather hose extends to one of the four trunks, being firmly attached to each. These cylinders being charged, by the power of the steam engines, with fifteen atmospheres of compressed air, the vessel to be raised is floated between the scows, or if the vessel lays at anchor, the scows may be propelled by the steam power, to a station on each side of the vessel, dragging the elevator with them, which is then raised by the ropes until the middle of the floor comes in contact with the keel of the vessel, and is secured in that position by several ropes or chains, which being attached to the sides of the elevator, are made fast to the timber heads of the vessel. Moreover, several chucks, or blocks, previously prepared and connected with the elevator, are placed under the bottom of the vessel to support the same in its position when raised. Then, by means of valves, the compressed air in the cylinders is permitted to escape through the hose into the interior of the trunks, which immediately gives them a buoyancy of about seven hundred thousand pounds. But if the vessel thus raised be of such a size as not to require so much power of buoyancy, the compressed air may be instantly shut off, whenever the floor of the elevator shall have risen fairly above the surface of the water.

While one vessel is being repaired, the cylinders are again charged; and when the repairs of one are completed, other valves are opened, which

permit the air to escape from the trunks, while the vessel settles readily, but gently, into the water, and the elevator is ready to receive another; thus avoiding the ordinary delay attendant on raising vessels by the usual method.

I claim the construction and mode of using the elevator generally.

RUFUS PORTER.

*Remarks by the Editor.*—We have been induced to publish the foregoing specification entire, because it describes the thing patented with a directness and clearness which may serve as an example to others. There is nothing extraneous about it, and we could scarcely, therefore, have done any thing like justice to it had we epitomized it in the ordinary monthly list. There is nothing new in the principle of raising vessels by means of air forced into hollow trunks, but the whole arrangement set forth gives a distinct and special character to the plan before us, by which it can undoubtedly be sustained.

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*Specification of a Patent for a Machine for Hulling Cotton and other Seeds.*

Granted to JOHN AMBLER, JR. City of Philadelphia, November 26th, 1835.

To all whom it may concern, be it known, that I, John Ambler, Jr. of the city of Philadelphia, in the State of Pennsylvania, have invented an improved machine for hulling and cleaning cotton and other seed, which I denominate the Metallic Cotton Seed Huller, and that the following is a full and exact description thereof.

Upon an iron shaft, revolving horizontally, I place two, or any other convenient number of steel or iron disks, or circular plates of metal, so as to run with perfect truth upon the shafts; disks of eighteen inches in diameter, I have found to answer the purpose perfectly well. By means of a pointed chisel I raise teeth, in the manner of rasp teeth, on each side of these revolving disks, or I groove, or roughen them in any other manner calculated to produce the intended effect. The disks, as they revolve, pass through the flat bottom of a hopper, by which they are surmounted, projecting above the said bottom about one third of their diameter. Steel plates, cut like the disks, are placed on each side of them; the upper edges of these plates are on a level with the bottom of the hopper, and they extend down to the lower part of the revolving disks, covering about one-fourth part of the face thereof, this having been found sufficient to effect the hulling, perfectly. These lateral plates are attached to adjustable sliding bars, or fixed in any other way which will admit of their distance from the disks being regulated according to the kind of seed to be hulled. It has been found best not to increase the opening between the plates and disks at the upper edge, but to preserve their parallelism throughout, so that but one seed can find its way between them at a time.

The seeds and hulls fall upon a sloping skreen, or riddle, which is made to shake, and to carry the portion which does not pass through the riddle to a revolving picker, placed at one end of the frame; this picker, and the hollow segment within which it revolves, are set with teeth in the manner of a picker for wool, and serve to separate the matted portion of the hulls, cotton, and seed, so that the lighter portion may be driven off by a revolv-

ing fan placed at the lower part of the machine for the purpose of cleaning the hulled seed.

The riddles, screens, shakers, fan, &c. which I employ, do not differ from such as are in common use for cleaning grain and other seed, and do not, therefore, require to be particularly described, as they make no part of my invention, and may be variously modified, or used separately from the hulling apparatus.

What I claim as my invention, and wish to secure by letters patent, is the hulling of cotton, and other seed, by means of revolving disks, or plates of steel, or other metal, made and operating substantially in the manner hereinbefore set forth.

JOHN AMBLER, JR.

### Progress of Theoretical and Practical Mechanics and Chemistry.

#### *Economy of Steam Power.*

As this subject has latterly begun to attract the general attention it so well deserves, it is evidently of much importance that the nature of the recent improvements in question should be well understood, in order that their practicability, or rather *expediency*, under different local circumstances, should be properly appreciated.

Some persons appear to consider that the expansive working of high pressure steam, constitutes the *only* improvement by which the expenditure of fuel is so greatly economised in the Cornish engines. It is, therefore, very natural to state that considerable power is lost in obtaining this advantage. To a certain and limited extent this may be true, but the improvements in question consist, in great measure, of *other arrangements*, against which no such objection can be urged, and from which, therefore, unmixed benefit is derived, as I shall presently endeavor to show.

Although the expansive working of high pressure steam in the manner introduced by Mr. Woolf, is undoubtedly a very important feature in the Cornish steam engines, in their present improved state, their superior excellence and economy, is by no means to be attributed to *this source only*, as several other causes greatly contribute towards it. These causes are the following:—1st, An improved construction of boilers, by which the generation of steam is more rapidly and more perfectly effected. 2nd, in allowing a short interval between each stroke, by which means the condensation of the steam is perfectly accomplished. 3rd, (perhaps the most important feature,) the prevention, to a very great extent, of the usual escape of heat from those parts of the engine through which the steam passes, by the application of a *proper casing composed of substances known to be very imperfect conductors of caloric*. In this casing the boiler, steam pipes, and cylinder, are, of course, carefully enveloped. 4th, The great care and attention used in working the engines; all parties concerned being stimulated to exertion by the admirable system of publishing regular monthly returns of the duty, &c. of all the engines working in the county.

On the 3rd of these causes, or the application of casing, I lay much stress, both on account of its actual importance, and also of the ease and small expense with which it may in all cases be applied to engines, although not originally constructed with this intention. It appears, indeed, from experiment, that by this simple alteration (or rather addition) only,

that the duty of an engine may be nearly doubled, or, in other words, *its expenditure of fuel reduced one-half, without any diminution of its power*, a fact well deserving the attention of those who are concerned in the use of steam engines, whether in places where coal is expensive or not.

It is sometimes supposed that the engines now used in Cornwall, are constructed with two cylinders, in the manner introduced by Woolf—no engines of this kind have been employed there, however, for many years; all of those now working in the county being impelled by steam acting expansively in a *single cylinder*, as first proposed by Watt, although of course of great elasticity, in accordance with Woolf's great and acknowledged improvement.

It is doubted how far it would be prudent to adopt these improvements in the neighborhood of Glasgow, where coal is abundant. As the application of them of course involves some degree of expense, this is strictly *a matter of calculation*, and not of opinion; but, when the expenditure of fuel can be reduced one-half, (which I am convinced in many cases might be done,) by the simple application of casings in the manner before noticed, and without any loss of power, there is, I think, good reason for supposing that *this improvement, at least*, would be desirable in all situations, however cheap fuel may be. The waste of coal, arising from the unchecked radiation of heat in the engines used in our coal mine districts, must be enormous, nor can any thing be conceived more barbarous (unless, indeed, the *mere destruction of coal* be one of the objects in view) than the construction of the engines in the mines of Staffordshire, and other coal districts. The boilers are generally made of a somewhat spherical form, much resembling those employed in the earlier atmospheric engines, and, together with the steam pipes, stand detached from the engine house, and quite exposed to the air, having no roof or covering whatever. It is evident that an immense escape of heat must take place from these enormous surfaces, exposed as they are to all atmospheric changes. I have never ascertained the temperature of the outside of these boilers by a thermometer; the surface is, however, too hot to be approached by the hand, and as the exterior can only differ from the interior by refrigeration (certainly, under these circumstances, a rapid process) we may, perhaps, conclude, from the known conducting power of the metals, that it may even approach 200 degrees.

The following memoranda, made some time ago in Cornwall, will show how differently things are managed there.

United Mines, Little engine—a 30 inch cylinder—

Temperature of external atmosphere	. . . . .	67 deg. Fah.
Ditto of engine-room	. . . . .	68 deg. Fah.
Ditto of boiler-house	. . . . .	70 deg. Fah.

Cardozo's Engine—a 90 inch cylinder—

Temperature of external atmosphere, as before.		
Ditto of engine-room	. . . . .	71 deg. Fah.
Ditto of boiler-house	. . . . .	75 deg. Fah.

Consolidated Mines, Job's Engine—a 90 inch cylinder—

Temperature of external atmosphere as before.		
Ditto of engine-room	. . . . .	70 deg. Fah.
Ditto of boiler-house	. . . . .	72 deg. Fah.

These observations were made quite at random, nor were the best engines in the mines selected for that purpose, as there were others of superior construction and doing better duty. They will serve, however, to show

the extraordinary success with which casing is applied by the Cornish engineers, an improvement perhaps of greater general interest than any other, from its extreme simplicity, and the ease with which it may be applied in all cases where economy of fuel is desirable.

FREDERICK BURR.

*London Mining Journal.*

*Instances of Spontaneous Combustion, detailed in a paper read before the Royal Irish Academy, 25th May, 1835. By M. SCANLAN, Esq.*

In the beginning of last March, a fire broke out in the extensive turpentine distillery on Sir John Rogerson's quay, belonging to Mr. John Fish Murphy, which is separated from my chemical factory by Windmill Lane. The fire, which was speedily got under, was confined to a heap of what is termed, by turpentine distillers, chip cake, and from the circumstances under which it occurred, could not be attributed to any other cause than the act of an incendiary, or to the spontaneous ignition of this chip cake.

As spontaneous combustion of this substance has never occurred before in Murphy's distillery, nor in that of his father, an extensive distiller of turpentine for many years, at Stratford in Essex, I at first doubted that the fire could have originated in this way; however, on inquiry, I found his mode of working had been, on this particular occasion, different from that usually employed in his distillery, and, experiments which he kindly permitted me to make, have since proved beyond doubt that combustion did take place spontaneously.

Raw turpentine, as it comes from America, in barrels, includes a considerable quantity of impurity, consisting of chips of wood, leaves, and leaf stalks.\* It was the practice in Mr. Murphy's distillery, as it is in England, to heat the raw turpentine up to a temperature of about 180°, as I found by plunging the thermometer into one of his large copper pans, and to strain the turpentine, thus liquified, from the impurities, previously to introducing it into the still, where it is submitted to distillation in the usual way, with a portion of water, yielding turpentine oil, which distils over along with the water, and rosin which remains behind in the still. The chips when separated by a wire strainer, still retain a quantity of adhering turpentine worth saving, and with this view are transferred to a large close vat, where they are exposed for some time to the action of steam furnished by a boiler kept for this purpose, as well as for steaming the empty barrels, in order to remove any turpentine that may adhere to them. Still, however, the chips are a good deal imbued with resinous matter, and in this state form a loose porous mass, which the turpentine distiller calls chip cake, a material which is used by the poor in the neighborhood as fuel.

As long as the process I have just described was pursued, which is the London mode, and that which produces the best rosin, no accident occurred from fire in Mr. Murphy's premises, although I have frequently seen

\* The following extract from the letter of a French turpentine merchant, will account for the presence of these foreign bodies. To obtain the turpentine "the fir timber is chopped about a man's height down its side with an axe, not hand deep, and afterwards higher up. The turpentine or *rosin* is scraped up from the foot of the tree. That which is on the side wound, when scraped off, is white, and is called *galley pot*, of which the burning incense is made. It does not yield so much turpentine spirit as the pat."—*Ed. of Records of Science.*

immense heaps of this chip cake collected together in his yard; but, on making trial of a different plan, namely, that practised by a Dublin distiller, Mr. Price of Lincoln Lane, the accident in question occurred.

On this occasion the raw turpentine, together with its impurities, was put directly into the still, along with the proper quantity of water, and the boiling rosin at the end of the operation strained from the chips.

The chip cake resulting from a single operation thus conducted, was laid in a heap outside the still house at 3 o'clock in the afternoon, and at midnight was discovered to be in flames.

In the first mentioned process, it is obvious the chips were never exposed to a higher degree of temperature than  $212^{\circ}$ ; but in the latter, especially when it is the object of the manufacturer to make amber rosin, the temperature to which they are exposed is much higher.

The first experiment I made was on the 16th March. I found the temperature of the boiling rosin, in the still, to be  $250^{\circ}$ , when the turpentine oil and water had been distilled off; the fire just drawn from under the still, and when the liquid rosin was in the act of being strained from the chips which were introduced into the still with the turpentine.

I had the whole of the chip cake resulting from this distillation carried into my own yard, upon a wire screen, and left in the open air, with a view of watching its progress.

The temperature increased gradually in the centre of the heap, although externally it became quite cold and brittle. In four hours, in fact, a thermometer thrust into the centre of the *porous* mass indicated a temperature of  $400^{\circ}$ , a good deal of vapour was now given off, and the adhering rosin in the heated parts began to acquire a high colour; the smell could be perceived at a considerable distance from my premises; it was a mixed smell of pitch and rosin.

The chip cake, in this experiment, was first exposed to the air at one o'clock in the afternoon, and though it rained during the night, at half past seven the following morning it burst into a flame.

In a second experiment, I placed the chip cake in an open tar barrel, having three holes bored in its bottom, about two inches in diameter each, and it did not take fire till the expiration of thirty-six hours, but the temperature of the mass was lowered by removal from the wire strainer to the barrel, and besides, I am of opinion the limited access of air retarded the combustion.

In a third trial which I made, combustion took place in five hours; but in this experiment the temperature of the boiling rosin drawn from the still was  $260^{\circ}$ , and the chip cake was laid, as in the first experiment, on the wire screen; the wind, too, was very high. The screen, in this case, was raised a few inches from the ground, in order to let the rosin, as it melted, drip away, which it did in abundance.

It appeared to me as if the porous mass became slowly red hot, in the centre, like a pyrophorous, and as if the vapour and gaseous matter arising from the decomposed rosin which lay immediately beneath, were inflamed on coming in contact with it. I was standing by when it suddenly burst into flames, and I thought, at the time, had the melted rosin been permitted to drop into water, or had it fallen to such a distance as not to be kept liquid by the radiant heat of the red hot mass above, that there would have been no flame, but silent combustion.

I have since learned from Mr. Price, in whose distillery it has always

been the practice to put the unstrained turpentine into the still, that he was well aware of the fact which it is the object of this paper to record, from a fire having occurred several years ago on his premises, when in the possession of his predecessor, Mr. James Price, and that, ever since, they cool down the chip cake, immediately on removal from the still, with water, and afterwards use it as fuel under the still.

An instance of spontaneous combustion occurred with my friend Mr. Philip Coffey, of the Dock Distillery, which is worth relating while on this subject.

He had made a quantity of the mixture used in the theatres for producing redlight, a powder consisting of nitrate of strontian, sulphur, chlorate of potash, and sulphuret of antimony, with a little lamp-black. A paper parcel of this "red fire," of about a pound or two by weight, was left by him on a shelf in a store-room where there was no fire or candle-light; the following day, while reading in an adjoining room, he perceived a smell as if some of this powder were burning, and, on examination, he found it had ignited spontaneously on the shelf and was actually consumed.—[*Records of General Science, and Rep. Pat. Invent.*

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*Engraving on Copper in relief.*—This art has fallen very undeservedly into neglect. Nitric acid, with one fifth of muriatic acid, forms the best mixture for biting in.

To prepare the copper, cover it with fine pumice-dust and water, and rub with a piece of fine pumice stone, rubbing with a curved motion. When the whole surface is uniform, clean the plate carefully. The plate is now to be coated with a cement prepared as follows: pure and clean asphaltum, is coarsely powdered, and four ounces added to four of Burgundy pitch, previously heated to fluidity in a suitable vessel: the materials are well mixed and exposed to a gentle heat sufficiently long to vaporize all the water of the pitch. Six ounces of white wax are next added and the whole is gently heated until it has attained such a fluidity that on cooling it will have a proper consistence: a very important point in regard to it. The fluid is then poured upon a copper plate to cool, and broken into small pieces for use.

The cement just described is dissolved in oil of turpentine, then spread with a brush or pen upon those parts of the plate which are to stand out. With a steel point these lines are cut down to the proper degree of fineness.

When the cement is dry, make an inclosure by engraver's wax upon the plate, into which pour dilute nitric acid, and allow it to act as long as is necessary. Next clean the plate and with a roll of paper dipped in the cement give a coat of ink to the parts of the design. Bite in with stronger acid, and when the plate has again been inked and worked up with the grain, bite in with nitro-muriatic acid.

This operation affords an engraving in high relief and which may be worked off with very little touching. (*Jour. des Connaiss. Us. Prac. Aug.*)

*Densities of Metals affected by Wire Drawing, &c.*—In a memoir some of the conclusions from which have already been given in this journal, M. Baudrimont gives the following estimates of specific gravities, founded upon very delicate experiments. *Iron.*—Wires compressed, 7.6305; do. annealed 7.600; do. laminated 7.7169; do. annealed, laminated 7.7312; hammered iron 7.7433. *Copper.*—Button cooled slowly, 8.4525; wire compressed,

8.6225; do. annealed 8.3912; do. laminated 8.4931; do. annealed, laminated, 8.4719; hammered copper 8.5079. *Silver*.—Button slowly cooled, 10.1053; button laminated, 10.5513; hammered 10.4476; granulated 9.6323; brittle 9.8463; crystallized in plates 9.5538; wire of .007 inch diameter, 10.4913. *Annales de Chim. et de Phys. Vol. IX.*

*Preparation of Sugar from Starch*.—M. Guerrin Varey, gives the following process for preparing sugar from starch by the aid of malted barley. One hundred parts of starch are mixed in four hundred parts of cold water, the mixture is poured into two thousand parts of boiling water, and rapidly stirred. From this results a thin paste which is cooled to about 150° Fah. and an extract of thirty-five parts of barley, which has germinated, mixed in. Cold water is added. The temperature being kept at 140° to 150° Fah. the mass liquifies in about five minutes. Having been heated for two hours and a half, between the temperatures already named, the liquid is evaporated at the lower limit of temperature in vacuo, if possible, until it marks 34° of Baumé. It is then exposed to the air in shallow vessels, and in a few days yields a sirop which sometimes contains crystals. The sugars may be crystalized by treating with alcohol to purify them, and evaporating in vacuo. Animal charcoal is also used to deprive them of colour. *Ibid.*

*Liquid for Bronzing Medals*.—Water of ammonia  $\frac{1}{2}$  oz. nitre  $\frac{1}{2}$  oz. dry sea salt  $\frac{1}{2}$  oz. sal ammoniac 1 oz. vinegar 48 ounces.—*Jour. des Connaiss. Us. et Prac. Sept. 35.*

*Substitutes for Platinum Points*.—Alloys which may be substituted for platinum points to lightning rods. Platinum 1, Zinc 1, Brass 1, Copper 6. Platinum 1, Mercury 1, Zinc  $\frac{1}{2}$ , Brass  $\frac{1}{2}$ , Copper 6. These alloys oxidate with difficulty.\* *Ibid.*

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## Civil Engineering.

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*Proportion of drainage to fall of Rain*.—The following deductions are made from two interesting tables, containing the fall of rain and the amount of drainage in Eaton brook and Madison brook valleys, in the State of New York. They are taken from a report of John B. Jervis, Esq., Chief Engineer of the Chenango Canal, to the Canal Commissioners of the State of New York.

From table No. 1. it appears, the average drainage, from June to December, 1835, inclusive, (7 months,) was 0.392 of the falling water or nearly  $\frac{2}{5}$ ; and the average from June to October, inclusive, (5 months,) was 0.319, or nearly  $\frac{1}{3}$  of the fall: August is the minimum month, and shows a drainage of 0.192, or nearly  $\frac{1}{5}$  the fall: July is the maximum month, (except December, which drained the snow of November,) and a drainage of 0.414, or over  $\frac{2}{3}$  of the fall.

From table No. 2, it appears, the average drainage for the year 1835, including the snow on the ground on the 1st of January, was 0.449, or nearly half the falling water: January to May, inclusive, (5 months,) 0.662, or say  $\frac{2}{3}$  of the fall: June to October, inclusive, (5 months,) 0.246, or say  $\frac{1}{4}$  of the fall. It will be observed that the quantity drained from June to

\* *Query*. Will they replace platinum in difficulty of fusion? if not, the points would become knobs, by powerful discharges.

October, inclusive, was very uniform; although the falling water is very different; which causes a great range in the ratios for the several months. This was produced by the reservoir on Madison brook, which retained the flood waters, and discharged them nearly uniformly through the reservoir pipes, causing the highest ratio to appear in the month of the least fall, and the smallest ratio in the month of the greatest fall of water. It is therefore obvious, that an average of June to October, (5 months) will be required to give a proper view of the drainage during the season of the greatest evaporation.

From June to October the Eaton brook valley gave a drainage of 0.319, and Madison brook valley 0.246 of the falling water. This result, it is believed, has been produced by the different characters of the two districts drained. The Eaton brook valley is, in itself, very narrow, and the grounds that drain into it are, generally, quite steep, and the soil is mostly of a very close texture. The Madison brook valley is much wider, the slopes of the adjoining lands that drain into it are more easy; and the soil, in some parts, is more porous than that on Eaton brook. In both cases the country is cultivated, and presents the usual proportion of cultivated and timbered lands, that is generally considered necessary in farming districts.

The Eaton brook valley, I should think, would afford more than an average drainage over a large district of the country, including the usual varieties of soil; and the Madison brook would, probably, not differ materially from the general average.

The calculations which the undersigned originally submitted on this subject were based on a drainage equal  $\frac{1}{2}$  of the falling water, which the experiments thus far show to have been too low. The average for the year, for the Madison brook valley, is 0.449, or over  $\frac{2}{5}$  of the falling water; and if we assume the drainage on Eaton brook, during the winter months, to be equal to that on Madison brook, for the same time, (which may be taken with safety,) the average for the year would be 0.523, or over half the falling water.

*Rail Road from Hartford to the Canadian line.*—The following is an extract from the proceedings of a convention held at Windsor, Vermont, for taking measures in regard to a Rail Road from Hartford, Connecticut, to the Canadian line.

The committee to whom was assigned the resolution directing an enquiry into the practicability of constructing the contemplated Rail Road from Hartford, in Connecticut, to the Canada line, through the valleys of the Connecticut and Passumpsic rivers, in reference to elevation, soil, materials, &c., and to estimate the expense of the same, beg leave to report:—

That, in their opinion, the same is highly practicable; that they have had under consideration the survey of Mr. Hutchinson through the valley of the Connecticut river from Hartford, in Connecticut, to McIndoe's Falls, in Barnet, Vermont, near the mouth of Passumpsic river, a distance of 220 miles, and the survey of De Witt Clinton, Jr. from thence to the Canada line on Lake Memphremagog, a distance of about 65 miles, showing a plan and profile of the country, surveyed for a canal on said route, being the same which is now contemplated for a Rail Road. Knowing those gentlemen to be professional engineers of high respectability, your committee have not hesitated to come to the conclusion, unanimously, that, so far as rise and fall are to be regarded, no unusual obstacle is presented; that, for so great an extent, the route is uncommonly level, and that there is no one point of

obstruction in the whole extent which may not be readily overcome, and that without serious expense.

That, in reference to the soil, in addition to the knowledge possessed by the committee individually, they have acquired such information as has been within their reach, and feel confident in affirming that throughout the whole route, the earth is feasible and of easy excavation; and that all the materials for constructing a rail road are found abundant and cheap upon every part of the line.

Your committee report, in reference to the expense of constructing said Rail Road, on the most permanent and improved plan, similar to the Boston, Worcester, and Providence roads, that the cost of superstructure, exclusive of grading, will be eight thousand dollars per mile, for a single track, including turn-outs; and that the grading, on an average, will not exceed five thousand dollars per mile for a double track, including masonry, bridging, engineering, and all contingent expenses. But, considering the abundance of timber in the vicinity of the route, suitable for constructing a rail road, and the facility for obtaining the same, other plans equally practicable and far less expensive might be advantageously adopted. The superstructure of the road with timber, without rubble-stone, might be constructed for six thousand dollars per mile less than the estimates of a road similar to the Worcester and Providence roads.

The estimated expense of a road, the whole distance, constructed upon the plan first mentioned, would amount to	\$3,705,000
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Upon the last mentioned plan,	1,995,000
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Making a saving in expense of	\$1,710,000
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It is well known that the surveys of Messrs. Hutchinson and Clinton were made for a then contemplated canal, and, of necessity, must have been confined to the streams; but in a survey for a Rail Road it seems highly probable to your committee that the route will be varied in many essential particulars.

Your committee further report, from the best information they have been able to obtain, that the route from the line of Canada to St. John's, a distance of about seventy miles, intersecting the Champlain and St. Lawrence Rail Road, is highly practicable and through a level and fertile country, and that from the well known enterprise of the inhabitants of the Eastern townships in the Province of Lower Canada, should the now contemplated Rail Road be extended to the Province line, a communication would soon be opened from that *terminus* to Montreal, and that the expense of constructing the same will not exceed the foregoing estimate; and they further report, that there is another route, in contemplation from the province line, through the valley of the St. Francis to the St. Lawrence, in the direction of Quebec, which is represented to be equally practicable, and affording equal facilities.

*Thames Tunnel.*—The excavation made for the Thames Tunnel is about 38 feet in width, and 22 feet six inches in height, presenting therefore, an opening exceeding 850 feet. The whole of this excavation including its two sides, which may be computed at 400 feet, is secured by means of a powerful apparatus designated the shield, as is also the roof it, which measures 350 feet. At full tide, the weight of both earth and water, which constitute the *superincumbent pressure*, is not less than 700 tons.

The *ceiling* of the shield consists of 24 or 26 pieces of cast-iron, donom

inated staves, closely adjusted; and as they are sometimes made to relieve each other, and therefore subjected to an increased load, they are for greater strength made like inverted troughs of cast-iron; their breadth is 18 inches, the depth of their sides 7 inches, and their length 9 feet, independently of a tail of wrought-iron which overlays the brick work. The edges in front are made sharp for entering the ground, and the external surfaces of the staves are planed very true. Similar staves are laid against the sides of the shield, all planed and equally well adjusted; each stave can be impelled singly as sheet piles are. Upon the whole the shield may be viewed as a coffer-dam, which, instead of being moved in a perpendicular direction, is placed and impelled horizontally. The standing part of the shield consists of 12 parallel frames, all independent of each other.

The front of this vast excavation is protected in a different manner from that of the sides. It is paneled all over with small boards, each of which is 3 feet long and 6 inches wide. There are, therefore, upwards of 500 of these boards, technically called *polings*, for covering the whole face of the excavation. Every one of these polings is held in place, and secured by means of two hand-jacks or screws, abutting against the frames. There are, therefore, upwards of one thousand of these jacks in action for securing the face of the excavation, or rather, for pressing against the ground with sufficient power to prevent any disruption of its various strata; for were the ground to be at all deranged, the pressure against the sides and front of the shield might soon increase to 2,500 or 3,000 tons, independently of that of the superincumbent pressure.

It is further to be remarked, that every successive tide, which at its full head is 76 feet above the foot of the excavation, causes an incessant variation in that pressure, tending to strain the hard strata, and to soften or knead the intervening soft ones; a fact quite unnoticed by projectors of plans, but which proved fatal to those who attempted the drift-way under the Thames in 1808. The pressure exerted against the front of the excavation by the agency of the shield, must therefore be uniformly kept at a maximum. The shield is advanced only 9 inches at a time, while the brick structure proceeds simultaneously.

It would be well if those who feel disposed to enter the List of Competitors were first to consult the report of those miners who directed the attempts that were made and carried on with so much perseverance, between the years 1803 and 1808, with the ultimate object of opening a road-way under the Thames at Rotherhithe. These were miners (Cornishmen,) engineers in that branch of the art, and, consequently, eminently qualified for the task in every respect; they were as sanguine too, as any of the projectors of this day; and their excavation was limited, in the first place, to a simple driftway, the height of which was only 5 feet, the breadth 2 feet 6 inches at the top, and 3 feet at the bottom, forming, therefore, an excavation that was sixty times smaller than the excavation which has been made for the Thames Tunnel. Diminutive, however, as this hole was when contrasted with that of the tunnel, the ground of the roof, though supported by substantial planking, gave way once in a fluid state, leaving an unsupported cavity over the roof of the driftway; still it held itself up; but a second accident of the same nature having occurred under a very high tide, the river broke the ground and entered the drift. In both cases it was the loose ground that first forced its way into the drift, and the river afterwards. The miners succeeded in filling the hole and in re-entering the drift, but the men could not continue the working; they were, according

to the engineer's report, driven out of it by the frequent bursts of sand and water, and it was acknowledged by him to be quite impracticable to proceed farther; so, after having probed the ground from underneath in many places, he concluded and reported that it was impossible to make an excavation of any size under the Thames.

But he resorted to one expedient which he conceived would answer the emergency—one which, at any rate, demonstrates the intrepidity of this engineer. That is, in order to clear or pass through the place which had been filled up in closing the hole made by the breaking in of the river, he reduced the height of his drift from 5 to 3 feet. The men and the engineers, too, had therefore to work on their knees. Awful enough for such a task! Thus reduced, the area of the excavation of this drift hardly exceeded the one-hundredth part of that of the Thames Tunnel under corresponding circumstances. [*London Mechanics' Magazine.*]

*General Statement of the Business of the Schuylkill Navigation Company, since its commencement.*

In 1815-16-17, no receipts. In 1818, total tolls, 233 00 dolls; in 1819, 1,202 16; in 1820, 803 07; in 1821, 1,792 60; in 1822, 1,054 97; in 1823, 1,964 58; in 1824, 635 00.

Years.	Total tonnage.	Tons of coal.	Toll on coal.		Toll on other articles.		Total toll.	
			d.	c.	d.	c.	d.	c.
1825		6,500	9,700	00	6,075	74	15,775	74
1826	32,404	16,767	25,147	00	18,961	87	43,108	87
1827	65,501	31,360	33,317	00	24,832	74	58,149	74
1828	105,463	47,284	46,202	00	40,969	56	87,171	56
1829	134,524	79,973	77,032	00	43,007	00	120,039	00
1830	180,755	89,984	87,192	00	60,973	95	148,165	95
1831	196,413	81,854	78,781	00	55,224	32	134,005	92
1832	327,921	209,271	199,784	00	65,045	70	264,829	70
1833	445,849	252,971	228,138	00	97,348	00	325,486	63
1834	395,720	226,692	204,490	14	95,350	91	299,841	05
1835	535,194	339,508	310,475	19	120,168	45	433,643	64

Years.	Descending toll.		Ascending toll.		Amount of rents.	
	d.	c.	d.	c.	d.	c.
1825	13,363	74	2,412	00	4,700	00
1826	32,968	97	10,139	90	4,900	00
1827	42,865	27	15,284	47	6,967	00
1828	64,001	56	23,170	00	7,618	00
1829	92,186	00	27,853	00	10,574	00
1830	105,231	36	42,934	59	13,800	00
1831	99,995	52	34,010	40	13,750	00
1832	218,218	00	46,611	70	15,207	00
1833	263,744	00	61,743	63	16,673	00
1834	246,266	14	53,574	91	16,687	67
1835	362,861	36	70,782	28	17,898	54

## Progress of Physical Science.

*The Time Ball at Greenwich.*—The following is a description of this apparatus.

*C*, the ball.

*A D*, a square mast on which it traverses, projecting through the eastern turret, *t, t*, of the observatory, and through the centre of the ball.

*m m*, the lead flat of the great room of the observatory.

*O B*, a circular iron plate, in which the mast is stepped, and which is steadied by the roof of the turret at *g*.

*F G*, an iron rod, to the upper part of which is fixed a part of the mast, and to the lower part, the piston, *G*. The upper end of this rod is of larger diameter than the lower.

*I*, an iron cylinder, with a stop-cock at *q*; the base, *a a*, on which it stands, being the level of the floor of the great room.

*R S T Y*, the discharging rod.

*V*, the cock, and *W*, the trigger, for discharging the ball.

*M*, the winch for raising the ball.

*N*, the chain for lifting the ball, and passing over the pulley at *O*.

*H H*, a strong iron plate, fixed in the wall, on which stand the two iron rods, *I I*, and which are fixed at the top, in the circular plate, *O B*.

*k*. These rods guide the piston rod, and also an iron weight, *K*, (passing through the lower part of it,) to the back of which weight is fastened the end of the lifting chain, *N*, after passing over the sheave at *O*.

The construction of the mast, and the manner in which the ball is made to traverse up and down it, is as follows.

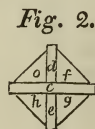
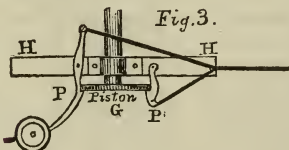
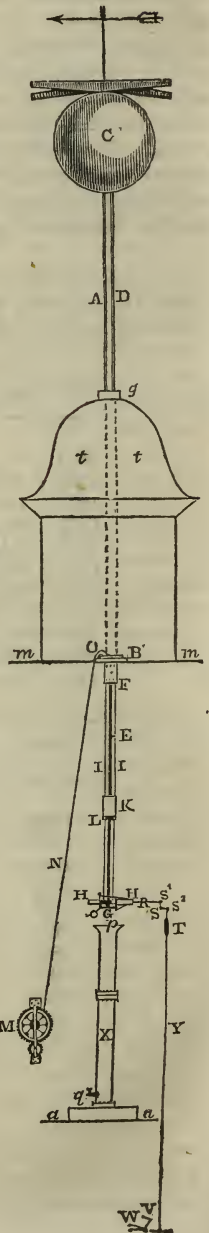


Fig. 2, represents a section of the mast at *d*, which will assist in explaining its construction. *c* is a solid piece of deal, (the whole length of the mast;) *d* and *e*, two other pieces screwed to it. The three angular parts, *h g f*, thus left, are filled by pieces extending the whole length, and firmly screwed in their places; but the part *o* is fitted by a piece, the upper end of which is secured to the upper part of the ball, and the lower end to the top of the piston rod at *F*.

When the ball is down, the weight, *K*, to which the chain is fastened, rests on the iron plate, *HH*, and the top of the piston rod, *F*, rests on a projecting piece at the bottom of the weight at *L*. The chain being fastened to this weight by means of the winch, is made to draw it, and, with it, the piston rod and ball.

The piston, *G*, being raised (as shown in the figure) to the iron plate, *HH*, forces its way between two detents, *PP*, which open and close on it, and thus support the ball.

The discharging rod, *RSTY*, has a crank at *S*, with two joints at *s'* and *s''*. *T* is a box, containing a strong spiral spring; the rod *Y* is secured to the bottom of this box, but the part of the rod above the box *T*, and below the crank at *S*, has a short movement within the box, in connexion with the internal spring. The purpose of this spring is, by acting against the ascent of the ball, when it is raised to the mast-head, to accelerate its descent when let fall, thereby preventing any adherence to the mast, and giving it rapid motion immediately.

*V*, the discharging part, has two notches, which serve to fix it at half and whole cock, in the same manner as the lock of a gun. When the ball is to be raised, the handle at *V* is raised to the half-cock; this raises the rod, *G*, and pushes the part, *R*, and prepares the detents, *PP*, for receiving the piston, which detents open, and are closed by means of the crank and the spring at *T*. When *V* is raised to the full cock, it compresses the spring, and exerts a greater force in keeping the detents closed. When the trigger, *W*, is pressed down, to discharge the ball, the rod, *G*, descends, and draws the part of the rod, *R*, to the right, which, removing the detents, *PP*, from beneath the piston, allows it to drop into the cylinder. The piston being adapted to the size of the cylinder, as it descends, compresses the atmosphere, and a resistance is thus obtained sufficient to break the fall of the ball, with its supporting rod in the mast. A brass cock at the bottom of the cylinder regulates the escape of the atmosphere beneath the piston, so as to allow the fall of the ball to be more or less, as required.

Fig. 3 shows, on a larger scale, the plan on which the detents are constructed.

When the ball is first raised to the mast-head, the weight, *K*, is at *F*; for the shoulder of the piston at *F*, resting on the rim of the weight at *L*, is thereby raised up with the ball. But before the ball is discharged, the lifting chain is entirely unwound, and the weight, *KL*, thereby descends, and rests on the plate, *HH*, in order to give the piston and ball freedom to descend.

During the time that it has been used, the ball has always been observed to commence its descent with 0.2s. after the impulse has been given to the trigger.

The time of discharging the ball is at the instant of one hour, P. M., mean time at Greenwich.

The mast is surmounted by a weathercock, and letters pointing to the four quarters of the compass.

[*Lond. Naut. Mag.*

*Occurrence of the Aurora Borealis at Toronto.*—Capt. Bonnycastle, R. Engineers, states that “during the winter months, on Lake Ontario, the aurora may be said to be almost a constant companion of the dark and cheerless nights, and it occasionally presents itself at all other times of the year.” He notices a remarkable constancy in the figures of the annual arches, as seen at Toronto, Upper Canada, and the constant appearance of the meteor in the arched form.

A splendid aurora occurring on the 11th December, 1835, is described and beautifully illustrated. [*Silliman's Journal*, vol. XXX., No. 1.]

*Machine for Registering the Variations of the Tide and Wind.*—The general principle of the machine is such, that a circular dial being fixed to the axle of a clock, revolves with a uniform motion once in twenty-four hours; a pencil is also moved vertically up and down by the rise and fall of the tide; which combined motions of the dial and pencil trace a curve upon the face of the dial, whereby the height of the tide, at any particular period of time, may be ascertained; also the time of high and low water, and the variable rate of ascent and descent.

The direction of the wind is indicated by a circular dial, fixed horizontally to the vertical axis of a wind-vane; and, by means of the clock, a pencil is made to move uniformly, at a given rate, from the centre of the dial, towards the circumference, so that, if the wind remain stationary upon any point of the compass, the mark traced by the pencil will be a straight line, radiating from the centre of the dial; but if the wind be changing, the dial will revolve, and the combined motions of the dial and pencil will trace out a curve, by which the direction of the wind, at any particular period of time, will be indicated.

[*Jameson's Journal*.]

*Colour of the sky as seen from high mountains.*—M. Bousingault comparing his own observations upon several high mountains, is disposed to attribute the blackness which the sky sometimes presents, to the effect of strong light reflected from the snow and ice upon the eyes. He observed a remarkable difference of tint in the sky seen from the highest point of Chimborazo which he was able to reach, and from the plain. On the ascent of Antisana at a much lower elevation, the sky seen from the icy plain appeared black, and in the evening of the day of observation he was struck with snow-blindness.

In no ascent has he been able to see the stars in day time, an experiment which he made fully in his ascent of Chimborazo. [*Ann. de Chim. et de Phys.*]

*Height of Barometer, &c. near the top of Chimborazo.*—On his ascent of Chimborazo, M. Bousingault found the barometer to stand at 14.47 inches at 2 P. M., the thermometer being at 46° Fahr. The height above the level of the sea was 6004 metres (6670 yards.)

[*Ibid*.]

*Expansion of Liquefied Gases, &c.*—The very remarkable fact of the expansion of liquefied carbonic acid, lately observed by the French academicians, has been fully verified by Mr. Kemp, lecturer on chemistry, who finds that the expansion is not peculiar to this liquefied gas, but belongs to all other gases in the liquid state. At a meeting of the society of arts, Mr. Kemp exhibited a specimen of the liquefied sulphurous acid gas, hermetically sealed in a glass tube, and separated from the materials from which it had been generated. This specimen of the liquefied gas occupied eight inches of a tube, five-eighths of an inch in internal diameter, and when cooled from the temperature of 60° down to 14° of Fahr., or the point at which it becomes liquid under the ordinary pressure of the atmosphere, it contracted one inch; but when heated an equal number of degrees above 60°, viz. 46°, it expanded through a greater distance than it had before contracted, by the abstraction of an equal amount of caloric, showing that the expansion went on at higher temperatures in a slightly increasing ratio, so that the expansion between its liquifying point, viz. 14° and 212°, the boiling point of water, is nearly one-third of its whole volume, the pressure against the

expansion being at  $212^{\circ}$ , about twenty-five atmospheres. That this property does not belong to the liquified gases exclusively, but resides equally in all other fluids, when raised above their boiling points, is shown by the following experiment; thus, ether, when raised from the temperature of  $60^{\circ}$  to  $95^{\circ}$  of Fahr., or its boiling point, undergoes an inconsiderable expansion compared with the expansion produced by an equal increase of temperature above its boiling point, when it may be said to be in the same condition with the liquified gases, in regard to pressure, and suffers nearly an equal expansion, by an equally increasing temperature with the liquified gases.

[*Jameson's Jour.*

*Arsenic in English Sulphuric Acid.*—Vogel, of Munchen, infers, from his experiments on sulphuric acid:

1. That the Nordhausen acid, prepared from the sulphate of iron, contains no arsenic; the precipitate with sulphuretted hydrogen being pure sulphur.

2. Concentrated English sulphuric acid, prepared in leaden chambers, contains arsenic, and the precipitate produced in it by a current of sulphuretted hydrogen, consists of sulphur and orpiment.

3. No precipitate of sulphur takes place, in consequence of a current of sulphuretted hydrogen being passed through English sulphuric acid, diluted with from four to six parts of water; the precipitate consisting of an orange yellow powder, or orpiment.

4. Rectified English sulphuric acid contains no arsenic, this substance remaining in the residue. The rectified acid, diluted with water, is not rendered muddy by sulphuretted hydrogen. The German sulphuric acid, diluted with water, becomes white when the latter gas is passed through it, as it always contains sulphurous acid.

5. The arsenic always exists in sulphuric acid in the form of arsenious acid, never as arsenic acid.

6. Concentrated boiling sulphuric acid can dissolve one-third of its weight of arsenious acid, of which the greater part separates on cooling. The arsenious acid may be precipitated, in a great measure, from the concentrated sulphuric acid, when cooled, by absolute alcohol, although it is somewhat soluble in alcohol.

7. Lastly, it is absolutely necessary that in all preparations to be used internally, rectified, or, at least, German, sulphuric acid, should be employed.

[*Thomson's Rec. of Sc.*

*On the Mineral Waters of Nevis.*—M. Robiquet attributes the principal virtue of these waters to an organic substance heretofore described by M. Longchamps, and called *baregene*, but which M. Robiquet refers to the vegetable kingdom as an organised matter. The nitrogen which enters into the constitution of this plant, is derived, according to the same writer, from atmospheric air, existing in cavities through which the waters pass. When the spring water is first drawn nitrogen escapes, and the water, notwithstanding its high temperature  $112^{\circ}$  Fah. retains a mixture of nitrogen and oxygen, in which the latter element is in greater proportion than in atmospheric air. [*Ann. de Chim. et de Phys. vol. LX.*

*Analysis of the waters of the Gray Sulphur Springs.*—The springs “are situated among the spurs of that portion of the Allegherry mountains which passes through Virginia, on the borders of Monroe and Giles counties.” The waters analysed by Prof. Shepard, of South Carolina College, have yielded Nitrogen, Chlorine, Carbonic Acid, Sulphuric Acid, Hydro-Sulphuric Acid, Silica, Crenic Acid, Soda, Lime, Alumina, Iron and Sulphur.

These constituents, he states, from his examination, exist probably as Nitrogen, Hydro-Sulphuric Acid, Bicarbonate of Soda, a super Carbonate of Lime, Chloride of Calcium, Chloride of Sodium, Sulphate of Soda, an alkaline or earthly crenate, or both, Silica, Sulphuret of Iron, per crenate of iron, Alumina, Silicate of Iron. [*Silliman's Journal*, vol. XXX. No. 1.]

## Mechanics' Register.

*British Projects for 1835.*—The following abstract is made from an article in the London Magazine of Popular Science, for February, 1836, where the particulars are given at large:

Number of projects relating to steam, ten; amount of capital required, 1,889,000*l.* Gas, three projects; capital required, 295,000*l.* Mines, forty-one; capital, 3,006,200*l.* Railways, thirty-seven; capital, 35,424,000*l.* Miscellaneous, thirty; capital, 9,343,000*l.* Total capital required, 49,957,200*l.*, or nearly \$204,000,000! A few of them are foreign schemes.

*Desiderata in the Construction of Stage Coaches.*—The greatest possible height of all the wheels; greatest possible depression of the body; shortness of perch; length of axletrees; diminution of bearings and tires; length and pliancy of springs. [*Parnell on Construction of Coaches. Rev. in Lond. Mag. Pop. Sc.*]

*Beet Root Sugar.*—At the recent meeting of the German naturalists, at Bonn, the section of agriculture and rural economy was almost entirely occupied with papers and discussions on this subject. At Valenciennes, a manufacturer has succeeded in discovering a method of crystalizing the whole of the saccharine matter of the beet, without producing molasses in the process. [*Ibid.*]

*Harrison's Chronometers.*—It is stated that Harrison, of London, received from the government for his chronometers, at different times, sums amounting to one hundred and ten thousand dollars. [*Naut. Mag.*]

*Hint to Dyers.*—A practical dyer of Troyes, in France, asserts that the acetate of iron is much preferable to the sulphate, in dying blacks. That stuffs which are injured by washing in caustic leys, or even soap, may be cleansed by rubbing in a weak starch bath. [*Bulletin Soc. d'Encouragement, &c.*]

*Hint to Bleachers.*—The same individual states that muriatic acid, used instead of sulphuric, in decomposing bleaching salts, does not render woollen goods harsh, as is often the result of the common acid bath. [*Ibid.*]

*Cast-iron Piano.*—The society for encouraging the arts at Rouen, France, have awarded a premium to Messrs. Eder & Gaugain, for a piano, the frame of which is of cast-iron. The strength of this material, in proportion to its bulk, gives it advantages over wood. [*Ibid.*]

*Experiments on Hydraulic Cements.*—The society for the encouragement of national industry in France, have appropriated six hundred francs for experiments on the different hydraulic cements. [*Ibid.*]

*Preserving Marble by Wax.*—It is well known that some of the inferior varieties of marble are acted upon by frost. A Mr. Henning, in London, has preserved several sculptured pieces, by causing them to imbibe wax. The stone and wax are both heated. [*Lond. Mech. Mag.*]

*Steamboat Lexington.*—This boat, which ran, during the summer, between New York and Providence, making the passage by daylight, is dis-

cussed in the London Mechanics' Magazine, under the title of the "Fastest Ship in the World."

*Greenwich Railway Project.*—This extraordinary project is to carry a railway upon a viaduct from London to Greenwich, three and three-quarter miles, on a series of between 900 and 1000 arches. This *arcade* to be a series of shops.

*Action of Salt Water on Cast-iron.*—Sea water so alters the nature of cast-iron, that its cohesion appears to be quite destroyed. Cannon which have been fished up, after lying long in the sea, have been found converted, through their substance, into something resembling plumbago, and admitting of being cut with a knife. [*Mining Journal. Naut. Mag.*]

*Statue of Brick and Mortar.*—A statue of the late king George the Fourth, erected at London, is built of bricks and mortar, coated, we presume, with cement. [*Loudon's Arch. Mag.*]

*Whalebone Pen-holders.*—These holders for metallic pens are highly recommended for flexibility, by a correspondent of the London Mechanics' Magazine.

*Mineral Pitch Lake of Trinidad.*—This extraordinary body of mineral pitch is about half a mile in length, and a sixteenth of a mile in breadth. Numerous pools of water exist on its surface. The mineral is hard enough to bear the weight of a man of common size, unless when heated by the sun. It is unlike vegetable pitch, being allied to coal. It is used by the inhabitants of Trinidad for making roads, and cementing stones under water. Gas has been made from it. [*Jameson's Journal, from Webster's Voyage.*]

*Canadian Twin Steamboat.*—A large steamboat is said to have been constructed at Prescott, Upper Canada, upon a principle similar to that of Mr. Burden, but with improvements. The thing will prove, probably, as little applicable to practice in the improvement, as in the original.

*Erection of the York Column.*—This monument, recently erected at London, to the Duke of York, is a Tuscan column, surmounted by a statue. The weight of the statue is 16,480 lbs., and it was raised to its place, 123 feet from the base of the column, in seven hours. It is said to have been greater in weight than any other statue raised to the same height in Great Britain.

*List of American Patents which issued in March, 1836.*

	March.
141. <i>Rolling Dough and Cutting Crackers.</i> —Wm. R. Nivins, city of New York,	2
142. <i>Power Printing Press.</i> —Isaac Adams, Boston, Mass.	2
143. <i>Fire Place and Stove.</i> —Foster Stevens, Springfield, Mass.	2
144. <i>Heat, management of.</i> —Lovell Lewis, Lewistown, N. York,	2
145. <i>Washing Machine.</i> —John O. Geer, Norwich, Connecticut,	2
146. <i>Fire Proof Safe.</i> —Daniel Harrington, Philadelphia,	2
147. <i>Cask and Barrel Headings.</i> —Hiram Andrews, Canaan, Conn.	2
148. <i>Mill Stone Picks.</i> —Samuel Etheridge, Tecumseh, Mich.	2
149. <i>Boring Wood.</i> —John B. Bell, New York city,	2
150. <i>Piano Forte.</i> —Issac Clark, Cincinnati, O.	2
151. <i>Brick Press.</i> —Phineas Ball, Mount Vernon, O.	2
152. <i>Furnace and boiler combined.</i> —Alexander Harrison, New Haven, Conn.	2
153. <i>Saw Mills.</i> —Isaac Reed, Mansfield, Mass.	2
154. <i>Carriage and car axle.</i> —Spenser Coleman, Mount Pleasant, Va.	2

155. <i>Dough Machine.</i> —D. D. and T. Shackford, West brook, Maine,	2
156. <i>Rotary stove caps.</i> —Maynard French, Albany, N. York,	2
157. <i>Feather Renovator.</i> —J. W. Post and R. Collier, Baltimore, Md.	2
158. <i>Churn.</i> —Amos Hanson, Windham, Maine,	2
159. <i>Printing Press.</i> —Samuel Kingsley, N. York city.	2
160. <i>Gauges, making.</i> —M. M. Brainard, Gt. Barrington, Mass.	4
161. <i>Pitch, composition.</i> —Thomas H. Sherman, Scriba, N. York,	4
162. <i>Gypsum applied to cisterns, &amp;c.</i> —J. Flint and C. Mills, N. York city,	4
163. <i>Lever key and lock.</i> —Augustus Prutzman, Philadelphia,	4
164. <i>Rail road cars.</i> —T. Davis and W. Ashdown, Baltimore,	4
165. <i>Water Wheel.</i> —Fred. Wingate, Augusta, Maine,	4
166. <i>Plough.</i> —W. P. Cannon, Monroe co. Tenn.	4
167. <i>Rudder.</i> —Samuel Kepner, Harrisburg, Pa.	4
168. <i>Boots, turning.</i> —Pelatiah Stevens, Stoughton, Mass.	4
169. <i>Printing Press.</i> —Hezekiah Camp, Trenton, Ohio,	4
170. <i>Smoke, consuming.</i> —Nathan Lockling, Sparta, N. York,	4
171. <i>Cotton gin grates.</i> —Edwin Keith, Bridgewater, Mass.	4
172. <i>Plough.</i> —D. Prouty and J. Means, Boston, Mass.	4
173. <i>Propelling Wheel.</i> —Arctus A. Wilder, Warsaw, N. York,	8
174. <i>Pump, double force.</i> —Levi Newton, Alexander, N. York,	8
175. <i>Splint for fractures.</i> —Enoch Thomas, New Athens, O.	8
176. <i>Smut machine.</i> —M. B. Spafford, Gainsville N. York,	8
177. <i>Pot and pearl ash.</i> —Elijah Williams, Erie, Penn.	8
178. <i>Mould candles.</i> —Jefferson Dunlap, New Holland, Penn.	8
179. <i>Brick Machine.</i> —John Moffat, Buffaloe, N. York,	8
180. <i>Appling heat from lime, &amp;c.</i> —Peter Werm, Philadelphia,	8
181. <i>Steam generator.</i> —Job Car, Springborough, O.	12
182. <i>Washing machine.</i> —Albion P. Arnold, Readfield, Maine,	12
183. <i>Forcing pump.</i> —William W. Lesuer, Venice, N. York,	12
184. <i>Water wheel.</i> —Abraham Straub, Milton, Penn.	12
185. <i>Bed bug destroyer.</i> —Brittain Garrard, Maysville, Tenn.	12
186. <i>Fire places.</i> —Elijah Skinner, Sandwich, N. H.	12
187. <i>Cooking stove.</i> —John Liddle, Schohaire, N. York,	12
188. <i>Door locks.</i> —Abel Corant, Lowell, Mass.	12
189. <i>Fire place.</i> —William Burgess, Middleborough, Mass.	12
190. <i>Cap wire.</i> —Melville Kelsey, N. York,	12
191. <i>Piano fortes.</i> —Henry Hartge, Baltimore, Md.	12
192. <i>Capstan.</i> —Andrew Morse, Boston, Mass.	12
193. <i>Cotton press.</i> —J. Mitchell, Ruthford, Tenn.	12
194. <i>Tooth extractor.</i> —Moses P. Hanson, Bangor, Maine,	12
195. <i>Paper, drying.</i> —Henry Howe, Shirley, Mass.	12
196. <i>Blacksmith's forge.</i> —Charles Richardson, Greenfield, N. H.	12
197. <i>Steam generator.</i> —John Ames, Springfield, Mass.	12
198. <i>Butt hinges, &amp;c.</i> —Welcome Whittaker, Troy, N. York,	12
199. <i>Detaching horses.</i> —Phillip T. Shore, Baltimore, Md.	18
200. <i>Braces, gum elastic.</i> —Ransom Warner, New York,	18
201. <i>Making extracts.</i> —T. Close and J. C. Sandford, Rye, N. York,	18
202. <i>Cook stoves.</i> —Charles Vale, Newark, N. J.	18
203. <i>Tanning.</i> —Henry Locher, Lancaster, Penn.	18
204. <i>White lead, making.</i> —Homer Hollard, Westfield, Mass.	18
205. <i>Break breaking machine.</i> —John Pursell, Perryville, Ken.	18
206. <i>Serving ropes.</i> —Adam Montgomery, N. York,	18
207. <i>Salt, making.</i> —Richard K. Crallé, Lynchburg, Va.	18
208. <i>Metallic mill.</i> —Joseph C. Dentry, Dayton, O.	18
209. <i>Morticing machine.</i> —George Page, Keene, N. H.	18
210. <i>Feathers, dressing.</i> —Elam Wilbur, Geneva, N. York,	18
211. <i>Door lock.</i> —James McClory, N. York,	19
212. <i>Pitch, making.</i> —Henry Ruggles, N. York,	19
213. <i>Fire places.</i> —Wm. R. Prescott, Hallowhill, Maine,	19
214. <i>Steam Generator.</i> —Eliphalet Nott, Schenectady, N. York,	19
215. <i>Pen and pencil case.</i> —Henry Withers, N. York,	19

216. <i>Fore anvil block.</i> —Samuel Van Tiers, Hanover Iron Works, Penn.	19
217. <i>Boats, passing over dams.</i> —Stephen Underwood, Bath, N. H.	19
218. <i>Tanning.</i> —Laban Emery, N. York,	19
219. <i>Milk, preserving.</i> —John L. Granger, N. York,	19
220. <i>Cider mill.</i> —Christian Shaeffer, Lebanon, Penn.	19
221. <i>Cooking stove.</i> —Oren Wilson, Concord, Mass.	23
222. <i>Stove.</i> —Wm. M. Carmichael, Hempstead, N. Y.	23
223. <i>Shoe pegs.</i> —Reuben H. Thompson, Rochester, N. York.	23
224. <i>Cot bedsteads.</i> —Samuel Clark, N. York,	23
225. <i>Cask machine.</i> —Sumner King, Suffield, Conn.	23
226. <i>Dissolving caoutchouc.</i> —Patrick Mackie, N. York,	23
227. <i>Washing machine.</i> —E. Y. Watson, Albany, N. York,	23
228. <i>Cannon vent.</i> —John W. Cochran, Lowell, Mass.	23
229. <i>Cannon.</i> —John W. Cochran, Lowell, Mass.	23
230. <i>Mortising machine.</i> —Erastus M. Shaw, Wilbraham, Mass.	23
231. <i>Cotton roping.</i> —William Fowler, Fishkill, N. York,	23
232. <i>Straw cutter.</i> —James Hyde, Darien, N. York,	23
233. <i>Thrashing machine.</i> —Hugh and Isaac W. Edgar, Wayne co. Ohio,	23
234. <i>Rotary steam engine.</i> —David Ulam, Greenburgh, Penn.	23
235. <i>Boring stones.</i> —Andrew Turney, Reading, Conn.	30
236. <i>Bee hives.</i> —Sturgess M. Judd, Danbury, Conn.	30
237. <i>Forcing Pumps.</i> —John F. Rogers, Waterford, N. York,	30
238. <i>Power loom.</i> —Francois C. Lewis, Grafton, Mass.	30
239. <i>Mill.</i> —John Harman, Jr. York, Penn.	30
240. <i>Harness, rivetting.</i> —William Dukehart, Baltimore, Md.	30
241. <i>Water wheel.</i> —Carey S. Mercer, Franklin, Md.	30
242. <i>Wool spinning.</i> —John Wethered, Baltimore, Md.	30
243. <i>Cotton planter.</i> —Michael Beam, Buffalo, N. C.	30
244. <i>Lamp reflecting.</i> —John C. Fletcher, Springfield, Ohio,	30
245. <i>Hat block.</i> —W. W. Jeineson, Wheeling, Ohio,	30
246. <i>Joints in wood work.</i> —S. C. Batchelor, and N. S. Thomas, Watertown, N. Y.	30
247. <i>Wool spinner.</i> —Sykes and Conradt, Fredericktown, Md.	30
248. <i>Stove.</i> —John B. H. Swansey, Lynn, Mass.	30
249. <i>Hay, &amp;c. press.</i> —A. R. Chamberlain and A. Cleffin, Richmond, Maine.	30
250. <i>Wind mill.</i> —Job Wilbur, Fall River, Mass.	30
251. <i>Axes, manufacturing.</i> —Elisha R. Root, Canton, Conn.	30
252. <i>Forcing pump.</i> —Nathan Chapin, Penn Yan, N. York,	30
253. <i>Cotton plough, &amp;c.</i> —Harvey W. Pitts, Wilsonville, Al.	31
254. <i>Corn sheller.</i> —Abert W. Gray, Middletown, Ver.	31
255. <i>Springs for carriages, &amp;c.</i> —Newell Hungerford, Ithaca, N. York,	31
256. <i>Awl Haft.</i> —David M. Smith, Gilsum, N. H.	31
257. <i>Soles, cutting.</i> —Jonathan Hill, Belerica, Mass.	31
258. <i>Reflecting ovens.</i> —C. D. Van Allen, Penn Yan, N. York,	31
259. <i>Self motive power.</i> —J. J. Giraud, Baltimore, Md.	31
260. <i>Churn.</i> —Thomas Nicholson, New Market, Va.	31
261. <i>Hoe, cast iron.</i> —Benj. F. Boyden, Boston, Mass.	31
262. <i>Winnowing machine.</i> —Jonathan Beane, Montville, Maine.	31
263. <i>Conveying water.</i> —Samuel Hart, Baltimore, Md.	31
264. <i>Tew irons.</i> —John Shugert, Elizabethtown, Penn.	31
265. <i>Mill stones, cooling.</i> —Austin Taylor, Littleton, N. H.	31
266. <i>Spark catcher.</i> —Wm. Shultz, Philadelphia,	31
267. <i>Horse power.</i> —Richard Skinner, Williamson, N. York,	31
268. <i>Cooking stove.</i> —B. R. Pearson, Warner, N. H.	31
269. <i>Hydrant.</i> —David Horne, Baltimore, Md.	31
270. <i>Rail plates.</i> —A. M. McCrane, Montgomery, Ala.	31
271. <i>Rail roads.</i> —Nathan Reed, Belfast, Maine,	31
272. <i>Cancer ointment.</i> —Elias Gilman, Licking, O.	31
273. <i>Gripe chuck.</i> —David Peeler, Boston, Mass.	31

## CELESTIAL PHENOMENA, FOR JULY, 1836.

Calculated by S. C. Walker.

Day.	H <sup>r</sup> .	Min.				
5	13	3	Im. $\alpha$ Piscium,	,5,	N. 155°	V. 106°
5	13	55	Em.		266	217
21	8	43	N. App. $\gamma$ and $\lambda$ Virginis,	,4, $\gamma$	S. 0°5	
24	8	28	Im. A Ophinci,	,4,5,	80	75
27	9	46	Em.		253	262

## Meteorological Observations for March, 1836.

Moon.	Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun Inches.	2 P.M. Inches.	Direction.	Force.		
☉	1	30°	35°	29.60	29.00	S. S.W.	Moderate.	Inches.	Sleet—rain.
	2	32°	38°	29.73	30.00	W.	Bustering.		Clear day.
	3	30°	35°	30.06	.10	W.	Brisk.		Lightly cloudy—clear.
	4	26°	34°	.03	29.90	WSW.	Moderate.		Clear day.
	5	30°	34°	29.53	.60	SW. W.	Brisk.		Clear—lightly cloudy.
	6	31°	34°	.80	.83	NE. N.	Bustering.		Cloudy day.
	7	29°	41°	.73	.73	W.	do.		Cloudy—hurry of snow.
	8	29°	39°	.68	.68	SE. W.	do.		Cloudy—clear.
	9	20°	44°	.86	.90	NE. SE.	do.		Clear—lightly cloudy.
	10	29°	38°	.80	.55	SE.	do.		Fog—rain.
	11	31°	33°	.50	.65	W.	Bustering.		Flying clouds.
	12	13°	23°	30.05	30.15	W.	Moderate.		Clear day.
	13	13°	37°	.33	.23	NE. S.	Brisk.		Clear—lightly cloudy.
	14	40°	44°	29.10	29.85	S. W.	Moderate.		Partially cloudy.
	15	27°	38°	30.25	30.25	NW.	Brisk.		Cloudy—clear.
	16	52°	39°	.40	.40	E. SW.	Moderate.		Cloudy—clear.
	17	32°	38°	29.80	29.70	W.	do.		Clear—lightly cloudy.
☌	18	44°	40°	.70	.90	W.	Bustering.		Fog—cloudy.
	19	22°	32°	.90	30.20	W.	do.		Clear—cloudy.
	20	23°	36°	.95	29.95	W.	Light.		Flying clouds—clear.
	21	23°	36°	.95	.86	W. S.	do.		Clear—cloudy.
	22	31°	44°	.55	.55	W.	Brisk.		Clear—clear.
	23	31°	36°	.55	30.00	W.	do.		Clear—cloudy.
	24	25°	42°	30.04	.00	SE.	do.		Flurry of snow—snow squall.
	25	26°	42°	1.15	.20	NW.	do.		Clear—cloudy.
	26	20°	38°	.35	.40	W. SE.	do.		Clear—flying clouds.
☾	27	27°	50°	.92	.10	SW.	Brisk.		Clear day.
	28	35°	44°	29.30	29.90	NW.	do.		Cloudy—drizzle.
	29	36°	42°	30.00	30.16	N. E.	Calm.		Cloudy day.
	30	34°	54°	.50	.16	E.	Moderate.		Flurry of snow—drizzle.
	31	32°	54°	.30	.30	W. SE.	do.		Clear day.
	Mean	27.26	39.58	29.94	29.94			0.25	

Thermometer.

Maximum height during the month, 54. on 30th and 31st.

Minimum do. 13. on 12th and 13th.

Mean do. 33.42

Barometer.

30.40 on 16th &amp; 26th.

29.50 on 11th.

29.94

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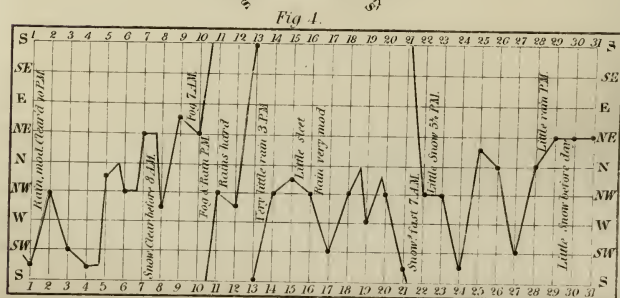
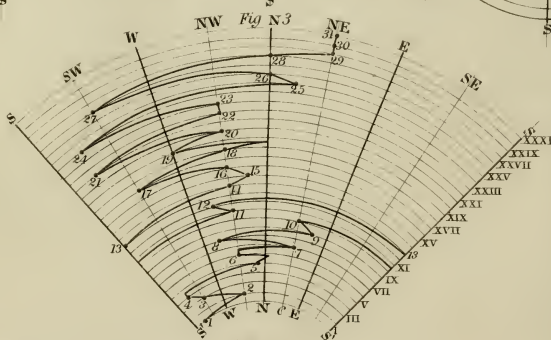
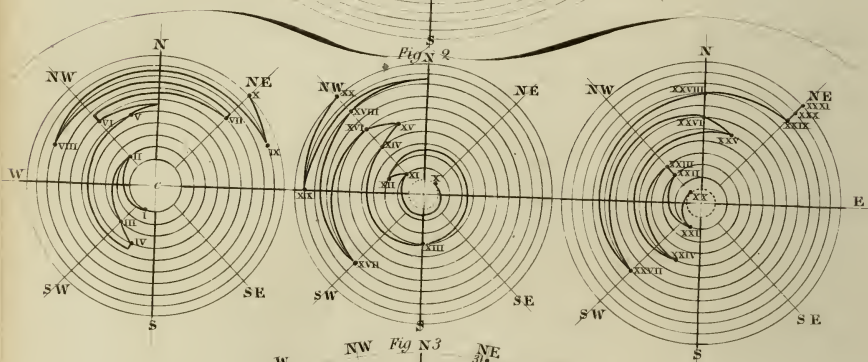
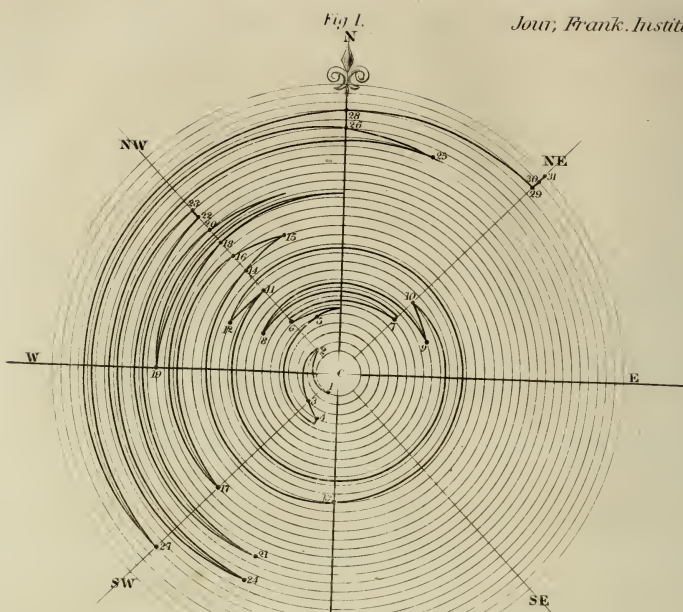
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*Experiments on the resistance of sand to motion through tubes, with especial reference to its use in the blasting of rocks, made at Fort Adams, Newport harbour, under the direction of Col. Totten. By Lieut. T. S. BROWN, of the Corps of Engineers.\**

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN: The great quantity of rock excavation required at Fort Adams, Newport, R. I. created, at an early period of the operations, an earnest desire, on the part of the officers of engineers charged with the construction of that work, to devise some method of loading and securing the drill holes which would be less dangerous to the workmen than the one which had been usually employed. For this purpose resort was had to the use of clean dry sand in the manner which will be hereafter described, it being understood that that expedient had been successfully tried at other places. It was found, however, that great prejudices existed among the workmen on this subject, and that from their belief of the inefficiency of the new method, they required to be constantly watched, to prevent them

\* We are compelled to divide this interesting paper. The first part, consisting mainly of a translation of the essay of M. H. Burnand, is now given, and the experiments which form the more important part of the paper, will follow in the next number.

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from jeopardizing their own safety, by returning to the old practice of filling the holes with fragments of stones and bricks, driven in with violence above the powder. It appeared to be important that the doubts of the workmen should be put at rest, and that several practical questions connected with the use of sand, in blasting, should be solved, and it was the intention of Colonel Totten, the superintending engineer, that experiments should be made for these purposes. This intention was confirmed by the appearance, in the "Journal of the Royal Institution," and in the "American Journal of Science," of brief notices, of a paper describing some interesting experiments on the flow and pressure of sand, which had been made in Europe. I was accordingly directed to institute a series of trials, having for their object, to determine the degree and nature of the resistance offered by sand when it is attempted to force it through a tube by direct pressure, and it was intended, at the same time, to investigate, more thoroughly, some of the properties of this substance which were developed in the European experiments just mentioned.

The experiments made in consequence of these instructions were prosecuted at distant intervals of leisure during the years 1829 and 1830, but they were interrupted before all had been accomplished, which had been originally designed; nevertheless, the results obtained were interesting, and it is thought that a brief account of them may be acceptable to the readers of your Journal.

Having, subsequently to making the experiments, procured, through the kindness of my friend, Professor A. D. Bache, a copy, in French, of the original paper above referred to, which has been several times re-published in Europe, I have translated it at length, from the "Annales de Chimie et de Physique," vol. XL, page 159, and prefix the translation to the summary of my own investigations.

#### TRANSLATION.

#### *Letter of M. Huber Burnand, to Professor Prevost, on the flow and pressure of sand.*

[M. Huber Burnand, two years since, presented to the Society of Physics and Natural History of Geneva, an anemometer, in which the force and duration of the wind, were measured by the quantity of sand which escaped from a variable opening, proportioned in size to the force which it was proposed to measure. On this subject, M. Prevost proposed the following question. Does not the sand in its flow, correspond in a certain degree with a liquid, and is not its discharge in consequence, more rapid, as the head in the vessel which contains it is greater? He indicated at the same time, the further researches which might be made as to the mode of action of the sand, in regard to the pressure which it exerts. Such is the origin and motive of the experiments submitted by M. Burnand to M. Prevost in this letter, which has been kindly communicated to us for publication.]

By preliminary trials, I ascertained that the two following precautions are necessary to obtain a tolerably regular flow of sand. First, it is indispensable that the sand should be sifted with the greatest care, but that it should not be as fine as flour. The sand used by founders would be too fine for this purpose; its fall would be irregular and would be frequently interrupted without any assignable cause. If, instead of this, we take the sand used in making tiles, and carefully sift it through a cotton gauze, the holes of which are produced by a web, which presents thirty-eight threads

by forty-five in the space of one square inch, we shall find it to flow with the greatest facility. The second condition necessary to the uninterrupted flow of the sand, is that the opening should have a diameter of at least  $\frac{1}{12}$  of an inch.

These first questions settled, I could proceed to the researches which I had in view. For this purpose, I had made two wooden boxes, one thirty-one inches high, with a bottom twelve inches square, and another forty-seven inches high, with a bottom only four inches square. They were open at the top, and provided at the bottom with four small boards, sliding in grooves disposed in the form of a cross, so as to permit the aperture to be widened or lengthened at pleasure. The slides were made thin, so that the flow should not be affected by the thickness of the wood, a circumstance the inconveniences of which, I had already discovered. These two boxes were raised on four legs, for the convenience of experimenting, and I procured an excellent stop watch to ensure accuracy in the results. The volumes were measured in a graduated glass tube, and I had also obtained a very sensible balance, with very exact metrical decimal weights. I must add that all my trials were repeated several times, and that I had acquired by long practice, such skill in these experiments, that an error of a quarter of a second in time, would have been detected in the results.

In the most delicate experiments, I introduced metallic slides graduated to  $\frac{4}{100}$ ths. of an inch, instead of the wooden ones: they were however, still by no means as exact as was desirable.

I shall divide my researches into two parts; those which have for their special object the flowing of sand, and those which refer more particularly to its pressure, as serving to explain the phenomena ascertained in relation to the first subject.

### *I. The flow of Sand.*

1. The quantity of sand which flowed in a given time from a given opening, was absolutely the same, both by volume and weight, whatever the height of the sand in the box at the commencement of the experiment. There were nevertheless, occasional variations, more or less, of two or three grammes.\* They were caused, most frequently, by the difficulty of introducing and withdrawing, at the proper moment, the vessel which was used to receive the sand. The errors compensated for each other, and disappeared when quantities as great as from four to five hundred grammes were employed. Three minutes were ordinarily employed in an experiment. The quantities obtained during the consecutive ninety seconds, were weighed, and when the weights were equal we called them accurate.

The weights were placed together, and compared afterwards with others obtained in the same manner, with columns of sand of ten times the height. The results were always perfectly alike.

2. The quantity of sand flowing through a hole from  $\frac{1}{8}$ th. to  $\frac{1}{12}$ th. of an inch wide, was always in direct proportion to the length of the opening, a fact which is susceptible of very useful applications in several Philosophical instruments. But the least variation in the breadth of the opening, caused in the quantity of sand flowing out, an increase, which exceeded the simple ratio of the surfaces of the orifice, as far, at least, as I could judge with the imperfect means which were at my disposal.

3. The sand escaping through openings in the side of the box, flow-

\*A Gramme is about  $15\frac{1}{2}$  grains. Tr.

ed with the same velocity whatever the height of the column was. But if the holes were placed horizontally, and had not a vertical dimension about equal to the thickness of the board, not a single grain of sand fell from them, whatever its height in the box.

4. Sand poured into one branch of a tube bent twice at right angles, does not rise in the opposite branch as a liquid does; it only extends a very small distance from the elbow into the horizontal part.

5. Whatever may be the pressure to which sand contained in a box is subjected, it does not influence in any manner, the quantity which flows out through a given opening situated at the bottom of the box or in the sides. The experiment was made successively with masses of iron weighing from twenty-six to fifty-five pounds.

6. A graduated rod inserted perpendicularly in the top of the column of sand, and precisely in the direction of an opening below, descends in and with the sand without inclining in any direction, and with a motion nearly as uniform as that of a clock. A rod fifteen inches long, was made at pleasure to descend  $\frac{4}{7}$ ths. of an inch per minute or per second. An overshot wheel placed in the interior of the box, and provided with an index outside, also moved with astonishing regularity, but very slowly. If the rod, instead of being placed in the axis of motion, was placed nearer the sides of the box, it inclined with great uniformity, but at the same time descended and advanced towards the centre with a very slow motion. The velocity of this rod depends then, principally on its position in the sand, and next on the size of the orifice. The velocity is probably also proportional to the ratio which exists between the surface of the orifice and the horizontal section of the box, since it depends upon the quantity which flows out during each instant, compared with the whole quantity.

With more care and several modifications of the apparatus, it would probably be possible to produce more regularity than I have attained, in the progress of movable bodies, carried along by the friction of the sand.

I will remark in passing, that there probably does not exist any other natural force on the earth, which produces of itself a perfectly uniform movement, and which would not be altered by gravitation, by friction, or by the resistance of the air. We see that the height of the column has no influence on the velocity of motion of the sand, neither increasing nor diminishing it. As to friction, far from being an obstacle, it is itself the direct cause of the regularity and uniformity of the movement, as will be shown in the sequel of my experiments; and the resistance of the air in the interior of a column of sand in motion, must be very small indeed, since none of the grains fall freely. The hour glass, a time piece, which preceded all others, was thus founded on a much more philosophical basis than has been supposed, and I venture to flatter myself that my researches may be of some use to it, in its application to the arts and to science.

7. After having studied sand in motion, I examined its mode of action when distributed in heaps upon a plane.

For this purpose I began by placing isolated grains of sand on a movable plane, susceptible of being inclined at will; they hardly rolled until the plane was inclined at least, under an angle of thirty degrees, and some remained at an inclination of forty degrees, but beyond this none remained at rest. Sand never assumes a level of itself; the angle, or the angles under which it usually presents itself, after a part of its mass has crumbled, are

almost always between thirty and thirty-three degrees; it rarely maintains itself at thirty-five degrees.

In a well sifted heap, the inferior layers, themselves inclined at thirty degrees with the horizon, serve naturally as supports to the superior ones; but the greater part of the weight of these latter, is supported by the portion of the horizontal plane against which they terminate or abut. If we take away this portion of the horizontal plane or bottom, these outer layers immediately roll off, leaving those on which they rested, undisturbed and inclined under an angle of from thirty to thirty-three degrees. This explains why sand does not flow out of a horizontal opening, if the thickness of the body through which the opening is pierced, is equal to or greater than the height, or vertical dimension of the orifice. In this case the superior layers find points of support on the sides of the containing vessel, and an absolute obstacle in the inferior layers.

Is this property connected with the form of the grains of which the sand is composed? If they had more regularity we might conjecture so, but upon looking at them through a microscope, we see such a variety of figures and dimensions that it is impossible to admit this idea. The greater part of the grains are crystalline laminæ, white, flattened and variously terminated; other particles are grey, yellow, brown, &c. with such different forms that they cannot be arranged into distinct classes.

In order to decide whether the form was of any importance in the arrangement of the parts, I tried other substances besides sand, and found that peas or small shot, although with a little more difficulty in forming them into slopes, took nearly the same angle, and followed in all respects the same laws.

## II. *Pressure of Sand and other Substances composed of Grains.*

1. An egg having been placed at the bottom of a box and covered with several inches of sand, the sand was loaded with a mass of iron weighing fifty-five pounds. The result was precisely what I had anticipated; the egg remained unbroken under the great weight which was placed above it.

I repeated this experiment, putting the sand in motion by means of an orifice at the bottom of the box. The result was the same, whether the egg was placed at the bottom or in the middle of the mass of sand.

These trials proved that the pressure excited by the mass of iron was deflected laterally by the interposition of the sand. They proved also, that a body placed in a mass of sand, is protected by it as it would be by a liquid, although the sand has a different kind of action from the liquid, on the sides of the vessel containing it.

These conclusions being somewhat paradoxical, I resolved to have recourse to more decisive proof.

2. I took a tube of glass open at both ends, and inserted it, vertically into a small horizontal tube of wood near one end, the other end of this horizontal tube being exactly fitted into a vertical cylindrical box  $\frac{1}{10}$ ths. of an inch in diameter and eight inches in height.

I filled this box with mercury, as if it had been the cistern of a barometer; the mercury naturally assumed its level in the vertical tube of glass. Its height in this tube was marked. I then adapted to the box, or cylindrical cistern, a large tin tube twenty-seven inches long, and one inch and one-third in diameter. I filled this large tube with sand, taking care to pour it in very slowly, so as not to agitate the mercury.

Here was a true barometer for measuring the weight of the sand; there

was an equal pressure of air on each side, so that apparently nothing prevented the equilibrium between the sand and the mercury. Although I had in part expected the result, I was surprised to see that the sand had added nothing to the weight of the mercury; the liquid kept its level to within  $\frac{1}{12}$ th. of an inch, a difference which was produced by an accidental shaking of the apparatus during the experiment; for having changed the place of the apparatus, the mercury resumed its level as before the experiment, and preserved it as long as I maintained this state of things.\*

I afterwards took the sand from above the mercury; it had not penetrated into the liquid. I substituted in its place dried peas; the large tube was completely filled with them, their weight being more than three pounds. I added an iron weight of upwards of two pounds, and lastly a pressure of the hand as great as I durst apply without endangering the apparatus. The mercury kept its level in the glass tube; not rising  $\frac{1}{24}$ th. part of an inch. The apparatus remained several days on trial without any other result. Thus the mercury had not been acted on by the weight of the sand, nor by that of the peas.

This absence of pressure on the bottom of a vessel was still better proved by the following experiments.

3. I took the same tube of tin and suspended it from a very sensible balance; I counterbalanced it exactly, and arranged it so that it reached nearly to the floor. I placed on the floor itself, a small solid cylinder of wood, about two inches high, and a little less in diameter than the large tube, so that the tube inclosed the cylinder, and could play freely in a vertical direction. As the tube was perfectly equipoised, and suspended to the arm of the balance vertically above the small solid cylinder, it moved upwards and downwards along this latter without any sensible friction.

I next weighed out a quantity of dried peas and introduced them into the large tin tube. It lost its mobility instantly, as if it had become more heavy, notwithstanding that it had no bottom, and the peas had a solid support on the top of the cylinder of wood.

I afterwards put into the opposite dish of the balance a certain number of grammes successively, until the dish descended, when the tube separated from the cylinder, allowing the escape of the peas which it had contained.

The weight required to raise the tube from the top of the cylinder was, within a very few grammes, equal to the weight of dried peas which I had poured into the tube; the difference was not more than twenty grammes, whilst the weight of the peas was more than three and a quarter pounds. The tube, therefore, appeared to be loaded with all the weight of the peas to which it gave its support.

The experiment repeated with different quantities and with additional weights always succeeded, and often within eight or ten grammes.

But it might be still objected that the lower cylinder had in some way supported the weight of the column. I therefore made the inverse experiment.

4 and 5. In this experiment I fastened the tube by two cords to two supports laterally, and suspended the small cylinder from the dish of the balance, in such a way that being equipoised before hand, it was introduced freely half an inch into the tin tube, and by the least additional weight it fell and permitted the escape of its load.

\* The experiment would have been more simply made with a tube bent like a syphon with parallel branches; but M. Burnand had none at his disposal.

I then poured about three and a quarter pounds of peas into the tube, and finding that the wooden cylinder which was perfectly free, did not fall, I added a weight of two and a quarter pounds and other weights, without even moving it. It might still be objected, however, that the small cylinder adhered to the sides of the tin tube. To answer this objection, and to render this experiment more striking, I removed the cylinder, and made use of a simple disk of wood of greater diameter than the tube, and supported against its bottom by placing in the balance just weight enough to keep the two in contact. This weight was commonly from ten to twelve grammes.

I then filled the large tube with from three to four pounds of sand, and placed additional weights upon the top of the column, nevertheless the disk, retained by the small counterpoise of ten or twelve grammes, did not move. If this same weight of a few grammes had been laid on that part of the disk which projected beyond the tube, it would without doubt have caused it to fall, for it alone retained the disk in its place. A slight touch of the finger, caused the sand to pour from the lower end of the tube, and fall into a basin placed below to receive it. The disk was therefore instrumental in retaining the sand, but did not sustain the weight of it, which was all transferred to the sides of the large tin tube. Ten grammes would have caused this disk to separate from the tube, and since it remained adhering to it, the disk was not loaded with the mass of the sand.

6. To remove all kind of doubt, I gave up the use of the balance, and placing a tub of water near the large fixed tube, floated the disk of wood on the water with the smooth side upwards; I then brought the end of the tube down upon the disk, and poured water into the tub. The disk was pressed by the weight of the water against the end of the tube. I next filled the tube with dried peas but the disk did not move. It, however, was essential in retaining the peas, which without it would have fallen through the tube; but the peas did not press upon it, since a very small force would have sufficed to make them fall from the tube and thus derange the whole apparatus.

7. Leaving every thing in the same condition, I poured water into the large tube; it was kept there with the peas, for a considerable time, until an unforeseen motion produced by the compressed air, which was disengaged from the bottom of the tube, caused the machine to incline. The peas then escaped into the tub, and the water flowed out at the same time. The same trial was made with sand; a considerable quantity of water was poured on the sand, fully impregnating it, and during a very long time it was supported without flowing out.

In another trial made a little differently, the sand took such a consistence with the water that it caused much trouble to get them out of the tube, which therefore entirely supported the weight of the sand and of the water, together with the force necessary to expel them.

8. We can make these experiments by simply causing the large tube to rest on a small conical heap of sand, whilst it is still suspended from the disk of the balance. The sand does not escape when the weight put into the other disk is nearly equivalent to the weight of the tube and its contents.

The same trials succeeded with grain: I have repeated them with shot with equal success, although this has a very great weight. They may also be made with a simple roll of paper tied with two small strings; they are then much more striking as the weight acquired by the paper tube contrasts better with its original lightness.

9. I have repeated these experiments with a tin tube widened at the bottom and much larger than the great tube; the result was the same, although there can be no doubt that there is a limit beyond which the sand would receive no further support from the sides of the tube. This will be the case when the inclination of these sides to a horizontal plane is the same as the slope assumed by sand in a heap, that is to say about thirty degrees. I have also repeated several of these trials with a cylindrical tube four inches in diameter, with the same success.

10. From all that I had seen I presumed that it would be very difficult to force sand through a tube even by means of a direct pressure. I made the trial in the following manner. I filled the great tube with sand and laid it in a horizontal position, and with a cylinder of wood, several feet in length, and a little less in diameter than the tube, endeavored to force out the sand at one end by pressing it at the other, but without success. It appeared to me that it would be easier to burst the tube than to move the sand a single inch. The tube being inclined to the horizon about twenty degrees, and the effect being thus aided by the weight of the body, the sand still could not be expelled; the same result followed in inclining the tube in the contrary direction. This explains very clearly why a blast confined with sand is as effectual as any other.

*Ynerduv, 15th January 1829.*

P. S. If in the experiment in section 2, under the head of the pressure of sand, we pour water into the tube which contains the peas, the mercury will rise in the glass tube one-fourteenth of the height of the water; a proportion which corresponds with that of the specific gravities of those liquids. The water acts as usual, but the peas exert no pressure.

2nd. There is another way of making the experiment with the tube which is within the reach of every body. Procure a tin tube an inch in diameter and as long as is desired, open at both ends. Take a sheet of fine paper and apply it against the end of the tube pressing up the edges with the hand so as to make it take its form; then moisten the edges of the paper with water and cause them to adhere to the sides of the tube. Place the end on a table and fill the tube with sand. Raise it with care, and notwithstanding the slight adherence of the paper, the sand will be sustained while the tube is freely moved about.

3rd. It would be desirable to place a vessel of sand provided with an orifice for its escape, under an air pump, in order to determine whether the velocity would be affected by its flowing in a vacuum.

[*Biblioth. Univ. XL, 22.*

(TO BE CONTINUED.)

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On the Manufacture of Military Projectiles, Translated from the French of H. J. Culmann, Chef d'escadron d'artillerie, &c. &c. by ALFRED MORDECAI, Captain United States Ordnance Department.*

The principal objects of this article are to point out certain faults in the manufacture of projectiles, and to indicate the means of giving them an even surface, an accurate eye, a thin seam, exact dimensions and perfect sphericity: on these points no detail will be neglected, but we shall not dwell on the description of processes which are well known in foundries.

*Of the Iron used for casting Projectiles.*

The kind of cast iron of which the best hollow projectiles are made is that obtained from very fusible ore, reduced with charcoal in furnaces of small elevation, at a medium heat, or by working the furnace in such a manner that the metal may be well mixed, inclining more towards a lamellar white metal than to grey, so that the laminæ, marked with greyish spots, may still be distinguished in it. The surface of a projectile made of this metal, which is very liquid, is perfectly smooth and free from flaws and holes, which is not the case with those made of grey metal, particularly of that which does not run freely. Metal inclining to white cannot be obtained with certainty from refractory ores, nor even from fusible ores if reduced with coke, or in furnaces of a certain height: this metal is moreover unsuitable for the manufacture of other articles, even for that of solid projectiles. In general, therefore the production of it is not desirable, and when accidentally obtained, it can seldom be used, because the projectiles made from it are too small; white cast iron, or that which inclines to white, shrinks more in cooling, or else at the instant of becoming solid, it expands less than the grey metal. In order to employ it usefully, therefore, the dimensions of the mould must be adapted to the properties of this kind of iron. It may also be doubted whether this brittle iron presents a sufficient resistance to the force of the powder, to prevent the projectile from being broken in leaving the piece, and to enable it to give, in certain cases, large fragments moving with sufficient velocity. It is used however in one of the iron districts of France, and with excellent results.

For the casting of hollow projectiles it is of little consequence whether the metal be good or bad, with reference to the quality of the fine iron obtained from it. It may even be said that the metal which produces a brittle iron, and which is generally very liquid, is better suited for this purpose than that which produces tough iron, provided that its bad quality does not proceed from the presence of too much silex, which would cause cracks and rents.

Castings which are to be very dense and solid, and of a medium thickness should not be made from the crude iron of coke furnaces, when it contains a large proportion of earthy minerals: a portion of the latter is thrown out when the metal is cooled by exposure to the air, and this causes flaws in the interior resembling rents; and when this metal is cooled without exposure to the air, interior crystallizations are formed, which also produce flaws. These phenomena, arising from unequal cooling, seldom occur if the castings are either very large or very thin; in the former case the metal being very liquid, heats the mould and then cools nearly at the same time throughout the mass; in the latter, the cooling is almost instantaneous.

Metal which does not contain a large proportion of earthy minerals has no tendency to form these crystallizations; an appearance which resembles them at first sight is sometimes produced by laminæ of graphite which in the cooling of the metal, collect in the interior of the mass. Crystallizations are frequently met with in the white grained metal, (when it is not produced by an overcharge of ore,) as well as in all kinds of grey-iron which contain earthy minerals.\* Unless we have the exclusive use of a furnace, the di-

\*These crystalline forms, so common in bombs, rarely occur in twenty-four pound howitzes, or in flasks. Out of thirty-eight ten inch and twelve inch shells, rejected for other reasons, which I have had broken, one third presented, in the fracture, crystallizations coloured yellow, crimson, &c. In six inch howitzes, we find rents produ-

mensions of the models, or globes, should be regulated according to the quality of the metal which in the particular foundry employed is best adapted for casting in sand, or for making most of the common cast iron utensils, and this is generally a mixed metal. The grey metal may also be used if it have the property of remaining liquid, which will be the case when the mixture of ore and fluxes is somewhat refractory; but if the grey metal should become thick and throw out a large quantity of graphite, it would give the projectile a very porous, wrinkled surface, covered with dross, and of an unseemly appearance. What we have said of the kind of metal best adapted for hollow projectiles, does not apply to that which should be used for making shot; white metal, or that which inclines to white, gives very ugly shot. The best is a slightly mixed metal, inclining rather to grey than to white, or else the clear grey metal, very liquid and having a pure slag. Such metal is easily obtained in furnaces fed with coke or charcoal. It is to be observed that the ore which furnishes brittle iron, whatever may be its colour, does not give as good shot as some of the ores from which medium, or tough iron is obtained; but the latter are generally of too much value for the manufacture in question. To obtain shot of an even surface, a certain quantity of the better quality should, however, always be added to the former kind.

We are at no loss to understand that white metal which, when poured into moulds, presents a very even surface, may furnish good shells, and at the same time be unfit for the fabrications of shot; because the latter must be rolled and hammered, and this metal is not adapted to either of those operations; the same may be said of almost all the ores of very brittle iron; they are not sufficiently ductile to take a smooth surface after having been hammered.

Grey metal which is a little thick, occasions, around the superior pole of the projectile, small cavities, very narrow and deep; especially if the metal has been reduced with coke of a bad quality, or from impure ores. In that case it contains a large quantity of siliceous matter, a part of which is separated from the metal by oxidation and cooling; if the ore is, besides, very fusible, the metal throws out graphite in cooling. This graphite and the siliceous matter thrown out are collected about the superior pole, where, mixed again with a certain quantity of metal, they form a soft spongy matter which gives a very bad appearance to the shot, and should cause its rejection—when metal

ced by the expulsion of the earthy minerals; but these substances are not entirely crystallized, because the metal of this projectile is thin and cools quickly. In the twenty-four pound howitzes these rents are for the same reason very rarely found, and never in grenades. The pellicles which so often appear on the surface of projectiles, are produced only by the crystallization of the earthy minerals. These troublesome accidents may be prevented by keeping the metal for some minutes in the ladles; when poured into the moulds it then becomes well mixed, and the tendency of the foreign substances to separate from the mass is counteracted; as the metal cools more quickly this separation becomes less easy, and the flaws are neither so great nor so numerous. This precaution should not be neglected in the fabrication of projectiles; if the metal be used too hot, depressions and cavities occur in cooling. These depressions, which are found about the eye, on the interior surface of six inch and eight inch howitzes, and ten inch and twelve inch shells, are caused by rents which often extend from the centre of the thickness of the metal to its interior surface. In some foundries most of the rejections are caused by the faults we have just mentioned, and we cannot too strongly recommend to those charged with the manufacture of hollow projectiles to allow the grey metal, when very hot, to remain a short time in the ladles; especially metal obtained, as it generally is for this purpose, from impure ore.

entirely grey has been obtained by means of charcoal from refractory and rather pure ores, it becomes more liquid, throws out less graphite, and is more suitable for making shot of an even surface; but small cavities may still be seen at the superior pole.

### *Of casting hollow Projectiles.*

The moulds for hollow projectiles are made of sand; clay was formerly used for the cores, but they are now also made of sand; at least it is to be hoped that this improvement will be generally adopted. Pit sand should be used for moulds; river sand has too little adhesiveness. It should be of a fine grain, and of such a consistence that it may stick together when pressed in the hands. If it contain too much earth it adheres to the casting, and gives it a rough surface: if too pure it has not sufficient consistence, and the moulds are easily broken and spoiled. The sand should however be as pure as it is possible to use it, in order that the surface of the casting may be more readily cleaned.

Sand which is too earthy may be easily corrected by the addition of dust from charcoal, coke or mineral coal, a very refractory substance which may be obtained perfectly fine, and which resists, in the strongest manner, the tendency to vitrification, and consequently to the adhesion of the sand to the metal. The dust of coke or of mineral coal is preferable to that of charcoal, and should *always* be used to give projectiles a fine surface. Calcination also furnishes the means of preventing the sand from adhering too strongly to the metal; and this method is naturally employed, by making use of the sand in which other castings have been made. It is necessary to mix it with fresh sand in order to give it greater consistence, and at the same time a certain proportion of the dust of coke or of pulverized coal is added.

Before using sand it is dried, then sifted, and properly worked and moistened: the quantity of water added should be the least possible to make it fit for use, because too much moisture may cause the casting to fail; there is however no danger to the workman in an excess of moisture, because the steam finding little resistance, passes easily through the sand without causing explosions, which often occur, in using clay moulds.

### *Of Sand for Cores.*

Sand for cores should of course contain more clay than that used for moulds, in order that after having been dried the cores may be so hard as not to be easily injured, and that they may adhere properly to the spindles. If the sand contain too much clay the core would not dry thoroughly without long exposure to a very high temperature. This inconvenience may be remedied by the addition of pure sand, or of coke dust, and by drying a second time.

In general, the quality of the sand and the degree of heat to which the cores should be exposed are dependent on each other. It is easy to succeed by subjecting them a sufficient length of time to a high heat; but the results are more certain, the operation is quicker and less expensive, when the sand is of the proper quality, having sufficient consistence not to be easily separated, and at the same time not retaining water with so much force as to require exposure to a very high degree of heat. If sand of this quality is not to be found on the spot, it may be composed by mixing the different kinds, or even by adding clay, provided however that it does not contain too great a proportion of calcareous matter, the proportions of the mixture are

soon determined by trial. But it is especially important to regulate the operation of drying according to the quality of the material used; when the casting fails and the projectiles are full of flaws, it may always be attributed to the presence of moisture. Whatever be the quality of the sand, it is prepared as described under the preceding head; that which has been once used cannot be again employed without the addition of fresh sand.

### *Of Clay for Cores.*

Although cores are now made of sand, we shall say a few words on the preparation of them from clay, and consequently on that of the clay itself: our remarks will apply also to the preparation of the nucleus of cores made of sand.

Argillaceous earth retains water with greater force, shrinks more in drying, and has a greater tendency to crack, in proportion, as it contains a greater quantity of alumina. The use of grey earths should be avoided, because they have not sufficient consistence; nearly all the earths which effervesce with acids are of this sort.

The clay is first dried, then pulverized, or rather beaten with a bat, to break the lumps, and sifted for the purpose of separating the pebbles, it is then moistened and well worked, adding at the same time about one third of horse dung. The viscous liquor contained in the dung prevents the clay from cracking, diminishes the shrinking, makes it less compact, less hard after drying, and easier to break when the shell is to be emptied. The clay used for the core of the *eye* should be passed through a silken sieve, and mixed with a smaller proportion of dung; the same may be said of that used for the last coats of cores made after the old method.

### *Of the models of Hollow Projectiles.*

The globe, or model, is generally made of copper: it consists of two hemispheres joined by a tongue and groove, in such a manner that they touch each other only on the exterior circumference; the inner part should be bevelled at a large angle: this is an essential point, for by this form the seam of the projectile is made thinner than it would be if the two hemispheres touched each other on a larger surface. The metal should be from three to four lines\* thick, so that it may not yield when the sand is rammed on it. The diameter of a model for any calibre is variable, on account of the different degrees of expansion and contraction of different kinds of cast iron: it always expands in passing from a fluid to a solid state, and afterwards contracts in cooling. This increase and diminution of volume varies not only in different foundries, but also in different kinds of metal obtained in the same furnace by working it differently.

In general the grey metal expands more in crystallizing, or contracts less in cooling, than the white metal; the former may give projectiles of too great dimensions, whilst those cast with white metal in the same moulds may be too small. The diameter of the model should therefore be regulated according to the quality of metal which, in the furnace employed, appears to be most fit for the object in view, and most frequently obtained. On the other hand

\*The French measures are retained in this article without reduction to the corresponding dimensions in English measures, because the former bear nearly the same proportion to the latter that the corresponding calibres bear to each other in the French service and in ours; besides they are easily reduced if necessary, to English measures; a French foot being equal to 12.79 English inches, very nearly. TRANS.

it advantageous for the service that the diameters of the projectiles should agree as nearly as possible with those of the largest gauge used in the inspection; which diameters, for twelve inch mortars and twenty-four and sixteen pounder guns, differ eighteen points from the calibre of the bore, and for other pieces, one line. It is only by trial, making the globe at first too large, that we can obtain the proper diameter, which should be such that the greater number of projectiles shall not pass through the intermediate gauge. To obtain this result it often happens that, for large calibres, the diameter of the model should exceed, by several points, that of the large gauge.

The addition of the dust of coal, or coke, to the sand facilitates the cleaning of the projectile and makes the surface more even, consequently the diameter smaller, so that a greater number pass through the intermediate gauge, or even through the small one. If water be poured on the iron whilst riot, it contracts more. (*See casting and finishing Projectiles.*) Hence the necessity of being well acquainted with all the circumstances of the manufacture, when by the first trials, the dimension of the model is to be determined; if too small it cannot be corrected by a coating of tin, as has been sometimes attempted; it would be necessary to procure a new one, which occasions a considerable expense.

The model should be turned and finished in all its parts with the greatest precision. It was formerly the custom to flatten the models of all projectiles very much at the poles: it was thought that the metal contracted more in the horizontal than in the vertical direction. We have for a long time contended against this opinion. Experiments have proved to us that the alleged difference in the contraction of the metal does not exist. If projectiles, *of a medium weight*, moulded with spherical models, are sometimes elongated, it is to be attributed solely to the unskilfulness of the workmen, who have not sufficiently compressed the sand about the lower pole: it then happens, especially in the case of large projectiles, that the weight of the metal, causing the sand to yield, produces the elongation in question. When the workmen have the requisite degree of skill and intelligence, the models of all hollow projectiles, below the calibre of ten inches, should be perfectly spherical: by flattening them we obtain many flattened, and ill shaped, projectiles. If, on the contrary, the models are spherical, the workman soon learns to ram the sand properly, so that the number of elongated projectiles is very small, whilst nearly all the others are perfectly spherical. Workmen generally prefer flattened models, because they are more afraid of obtaining elongated projectiles which will be rejected, than of producing a quantity of others more or less badly made.

The models of ten inch and twelve inch shells may be flattened from four to six points, as the sand cannot always be rammed sufficiently to prevent it from yielding to the pressure of these heavy castings. This explanation of the cause of the elongation of projectiles overthrows an absurd opinion, which has generally prevailed; there are, however, other causes of elongation which will be explained under the head of moulding.

The upper hemisphere of the model is pierced with a round hole intended to receive an iron spindle; in twelve inch shells the hole is nine lines in diameter; the length of the spindle is seven inches, four lines: it consists of three parts; one part is cylindrical and cut with a screw thread; it serves to fix to the hemisphere of the model a sort of handle by means of which it is managed: the second part is a truncated cone, all the dimensions of which are perfectly similar to another conical part on the spindle of the core, and it serves to prepare for the latter a lodgment in the sand. The third part is

nearly cylindrical, having also a diameter equal to that of the spindle of the core. In speaking of the flasks, we shall return to this subject. The upper hemisphere of the model of shells is pierced besides with two rectangular holes for the ears. Their position and form have undergone several variations; the following is the usual manner of tracing them. On a diameter perpendicular to the axis passing through the eye, lay off on each side three inches three lines, draw perpendiculars at these points, and with the radius of the twelve inch shell increased by that of the hole in the ear, cut the two perpendiculars at points which determine the centres of the holes: all shells being similar figures, the centres of the holes will be always found on the same radii. The diameters of these holes are laid down at four lines six points, for the twelve inch shell; three lines nine points, for the ten inch, and three lines three points for the eight inch. In practise it is necessary to make them a little larger, to afford the requisite play to the rings. It is essential that the mortices for the ears should be large enough to admit of their remaining in the sand, with the rings, after the hemisphere has been removed. Each ear is divided into two parts, which are generally joined by a tenon, so that they may be easily withdrawn in succession, without displacing the ring.

The ears placed as we have said, on a great circle, ought to fit accurately on the sphere, and form with it a continuous surface. The rings which are semi-elliptical, should be made with great precision, and finished with the file, so that the brazing, which is on the straight part, may not be visible. They are made of iron wire about two-fifths of an inch thick: it is necessary that they should play freely in the ears, and should fall down entirely on the surface of the shell. The diameter of the hole which they make should therefore be greater than their own: this is effected by enveloping them with a coat of clay, which should be quite round and well dried. When the shell is cast, this clay being removed, the ring has the requisite play.

The lower hemisphere of the model is also pierced with a hole which receives a piece called the *false spindle*; its dimensions are arbitrary; it is pierced at the inner end, with a mortice which receives a key. The other end is also pierced with a square hole in which is introduced a bar of iron or small ruler. The object of this spindle is to prevent the model from being detached from the mould when the flask containing it is raised; for this purpose a bit of wood is slipped under the rule; this acting like a wedge against the edge of the flask raises the rule and consequently presses the mould against the sand.

#### *Of the Spindle of the Core, and of the Pattern.*

The spindle of the core is divided into two parts by a swell several lines in height, in the form of a truncated cone, the base of which nearest to the core, has a diameter only three or four points less than the greatest diameter of the eye. The diameter of the other base is a little smaller than the first; in order that the spindle of the model, which should be perfectly similar to that of the core, may be withdrawn from the sand without causing any derangement of the mould. The dimensions of the part of the spindle opposite to the core are determined by the height of the flask, as we shall see further on. The part which supports the core, added to that which forms the eye of the projectile is equal in length to the distance from the upper circumference of the eye to the bottom of the shell, less a small quantity, and varying with the calibre: it is not important whether it be a little longer or a little shorter; the only essential point is, that the swell and the part of the

spindle opposite to the core, should be perfectly equal to their corresponding parts in the spindle of the model, and that the length of the swell be strictly determined according to the dimensions of the flask. We shall return to this subject.

The spindle may be either solid or hollow. Solid spindles having one or two deep grooves extending through their whole length, are also pierced, at the part which supports the core, with two rectangular holes in which pieces of slate are placed, to support the clay. In these grooves are placed straws to facilitate the disengaging of the gases. Hollow spindles intended principally for cores of sand, are pierced with five or six holes two lines in diameter. I think the latter kind preferable; they are besides easier to make, lighter, and less apt to spring than the solid spindles; they are made of sheet iron fifteen or twenty points thick, cut into pieces of proper size and rolled hot on a mandril. It is not necessary that the edges should be brazed together; it is sufficient that they join. The swell of the spindle is made by a ferrule which is brazed on. It is essential that the ferrule and all that part of the spindle which is to be similar to the spindle of the model, should be turned to the exact dimensions required. Both kinds of spindles should be flattened at the end opposite to the core, in order that it may enter into a crank; in that part there is also a hole to receive a key, when the core is placed in the mould. The other end should have a small conical indentation to receive the point of the screw which serves to fix the spindle in the lathe.

The dimensions of the core are determined by means of wooden patterns, of which there should be three, because the core is not finished at one operation. The radius of the first pattern differs ten lines, of the second four lines, from that of the core when finished; the third should give an exact section of the core, including that of the eye. The pattern is very easily drawn, for all its dimensions are given by those of the shell. A similar profile, made of iron, a gauge, and calibres for the eye, serve to verify the dimensions of the core. Before entering into the details of moulding, we shall describe the flask.

### *Of the Flasks.*

The flasks are boxes of wood, or of cast iron, without bottoms, divided into two unequal parts, each of which contains the mould of a hemisphere, and which are joined together by dowel pins, wedges, hooks, or small bolts and keys: the connexion by means of screws seems to me very defective.

The thickness of the boards of which wooden flasks are made should be from fifteen to eighteen lines for ten and twelve inch shells, and from ten to twelve lines for other projectiles. Wooden flasks are generally square; three of the angles are partly filled by triangular prisms of wood, to increase their solidity and diminish their capacity. The size of the flasks should be such as to leave a space of about an inch, or an inch and a half, around the model: if this space were greater, the preparation of the mould would require too much time; it would increase the expense, and at the same time impair the result of the operation, because the sand always yields more or less to the expansion of the metal, which is greatest at the points of least resistance, and this effect will be greater where the sand is thicker, the difficulty of ramming it firmly, being then increased. The part of a flask which contains the mould of the hemisphere in which the eye of a shell is placed, we shall call the *drag*; the other part the *cope*. The former which is ten inches eight lines deep for twelve inch shells, and to which the slides that receive

the wedges are adapted, contains a cast iron traverse, reinforced in the middle of its length, and pierced with a hole. The depth of this hole, or the thickness of the bar, or traverse, is four inches; its width is arbitrary. The hole, which is nine lines in diameter, receives the spindle of the model, the swell of which should rest exactly against this bar, as should also the swell of the spindle of the core. Accuracy in the position, and consequently in the thickness, of the sides of the projectile, depends therefore on the precision with which the bar is made and fixed in its place, as well as on accuracy and perfect identity in the form of the spindles.

This bar, or traverse, is therefore the most important part of the flask. If it were bent up or down the thickness of metal at the eye would be too great or too small: if its position were deranged laterally, the position and direction of the eye would vary accordingly. In verifying the flasks therefore the principal attention should be directed to the position, dimensions, and solidity of the traverses. They are let in their whole thickness into the sides of the flask, and kept in their places by screws, straps and keys. The depth of the drag is generally determined by the semi-diameter of the model added to the height of the swell of the spindle, and the thickness of the traverse. The sum of these three dimensions is ten inches eight lines for a twelve inch shell. The depth of the cope is equal to the semi-diameter of the model increased by two or three inches allowed for the thickness of the coat of sand: that depth is consequently from eight inches to nine inches in the example we have chosen. It may without inconvenience, be greater; but no variation can be allowed in the depth of the drag, unless corresponding variations are made in the spindles or in the thickness of the traverse.

When the flask is so arranged that the shell is cast with the eye downward, it is necessary to give the cope a greater depth than it would require if the shell were cast with the eye uppermost; because in the former case the sand in the cope is supported by the board on which the flask rests, but not in the latter.

Cast iron flasks have a round form with a swell or projection at the part where the gate is placed. The sides may be vertical, or may consist of two truncated cones placed base to base, giving a swell in the middle of the height. The two parts are connected together by dowels and ears through which key bolts pass. The traverses should be cast separately, and the holes drilled cold, to secure greater accuracy. In casting them at the same time with the flasks it would be impossible to avoid slight variations in all their dimensions; cast iron flasks are far preferable to wooden ones, because they can be better joined, and are much less subject to derangement, and the traverses can be adjusted in them with greater precision and solidity. We have already said that there is an advantage in having the coat of sand thin; but in that case the wood, affected by the heat and steam, becomes warped, which always causes errors in the dimensions of the projectile: hence another reason in favor of cast iron flasks.

The *gate* or channel by which the metal is conducted into the moulds is curved and terminates at the extremity of a horizontal diameter of the mould. It is called a *heel gate*, and it is formed in the sand by two pieces of wood, one of which, placed vertically, has a conical form: the diameter of its greater base is two and a half inches, that of the lower base is nine lines for twelve inch shells, and its height is necessarily equal to that of the upper portion of the flask: the other piece of wood which forms the heel, is

placed horizontally, meeting the model on one side and the vertical piece on the other; its ends are therefore cut to correspond respectively with the surface of the vertical piece and with that of the model; its form is flattened. The first of these pieces of wood is called simply the *gate*, the other the *heel*. In describing the process of casting we shall mention the several instruments made use of; but we must first say a few words on the subject of the lathe used for forming the cores made of clay, and the nucleus of those made of sand.

(TO BE CONTINUED IN OUR NEXT.)

*On Calcareous Cements.* By JAMES FROST, Civil Engineer.

No. IV.\*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Having seen the intense affinity between lime and water, we will now endeavour to examine the superior affinity between lime and carbonic acid; with which lime is always found naturally and definitely combined in the proportion of twenty-eight lime and twenty-two carbonic acid. It is also, generally or always found mixed, and seemingly in combination with other substances; for, in the purest white Italian marble I have always found some minute silicious particles. Yet, carbonate of lime we shall hereafter find is never chemically combined with those other substances—whatever may be the hardness or specific gravity of the mass;—and as this is seemingly a position of some importance in geological investigations, it will be hereafter adverted to in connection with another part of equal importance, when we have had the advantage of considering some other combinations of lime.

In England, lime is generally procured by calcining the carbonates in two different modes. The one and most frequent, is the cheapest and easiest in practice, but the lime obtained in this way is generally found inferior in quality to that obtained by the more troublesome and expensive process.

As lime of as good quality may be obtained by the easier process, we will endeavor to describe the necessary conditions. In the first mode, the carbonate is interstratified with the smallest and cheapest coal, in inverted lime kilns, and the fuel being in actual contact, acts with the greatest effect. The kilns are of the cheapest construction and maintenance, and being daily emptied of a portion of calcined lime, and daily charged with an equal proportion of fresh materials, the business is regularly conducted in the easiest manner—but the lime thus obtained is of a variable quality from some causes which must be explained in order to be avoided.

In the second mode the carbonates are piled in kilns so constructed that the fuel is burned in furnaces, and only the flame thereof admitted into the kilns to calcine the lime. In this mode, the coals used are large and of the dearest kind; more of them are required, as they do not act with so much effect; constant attendance is required night and day during the calcination; the kilns are more costly in construction and maintenance, and much expensive iron work is required.

If we calcine some limestone in an iron tube, or retort, set in a brick furnace, and then allow the retort to cool very slowly, while another portion of limestone is being calcined in a similar retort which is connected by an iron tube with the first so that the carbonic acid gas may be conducted

\* No. III. was published in the April number of this Journal, page 234. vol. XVII.

into the first retort, it will be there absorbed by the hot lime, which thus becomes uncalcined as it were, and is recarbonated more or less according to the care taken in conducting the experiment.

If we now enquire why the first mode is so uncertain, we shall find that the kilns are commonly constructed about equal in diameter and depth, and that the most careful workmen find it difficult, or impracticable, to draw the calcined lime, so that portions of it do not intermix with portions of the uncalcined and of the fuel. In which case, a portion of uncalcined lime escapes calcination, and a portion of that which is calcined becomes more or less uncalcined, and a very irregular article is thus produced.

If lime kilns were always constructed of two or three diameters in depth, careful workmen might always draw without intermixing the calcined and uncalcined strata in the kilns, and a good article would always be produced at the least expense of time and trouble, and that this mode will succeed in practice with any description of limestone, will be apparent, when we state that the most difficult carbonates to calcine, are those employed in the production of cements, which must be sufficiently calcined to become tender for grinding, while from their chemical qualities they are easily fusible with a small excess of fuel; now as these carbonates are well calcined in such kilns, it must be evident that all may be so, as no others can, from their nature, be so difficult to manage.

In either of the two modes of calcination the lime is allowed to cool in contact with atmospheric air, and this we have already seen is essential to the production of lime. For, if having calcined lime in a reverberatory furnace, wherein coke has been used for fuel, and if then a fresh supply of fuel be added, and the supply of fresh air prevented to the furnace and to the chimney, by closing the apertures thereto, and the lime be thus allowed to cool, it will absorb and condense much sulphuretted hydrogen as well as carbonic acid gas, and when cool, will be incapable of slacking with water, and if pulverised and tempered with water, it will set as cement, for a long time thereafter, exhaling the peculiar odour of sulphuretted hydrogen.

If, when the lime is about to be thus cooled in a reverberatory furnace, a portion of pine wood is added to the other fuel, the lime when cool, will be found nearly black throughout its whole substance by the vapour of carbon which has penetrated and been condensed therein; a black cement has been thus obtained, coloured probably, as some black marbles are found by analysis to be; the Kilkenny or black Irish marble, owing its color to its containing two per cent more carbon than white marble, which always holds twelve per cent combined with oxygen in its carbonic acid, and Kilkenny marble holds only two per cent more, but being uncombined, it acts as colouring matter, showing what a great difference in sensible qualities is made by a small difference in the quantities and chemical arrangement of the elements of solid bodies.

Every different species of carbonate requires a different quantity of fuel for its due calcination, the argillaceous varieties requiring a quantity very nearly proportioned to the carbonic acid in them; hence, the inference is, that the heat evolved is essentially employed in converting the acid into permanent gas. Thus, two measures of small Newcastle coals, are required for the calcination of ten measures of Thames chalk, and is sufficient for fifteen measures of Roman cement stone; but as this latter substance is about one third ferruginous and argillaceous matter, it would seem to require the expenditure of little fuel for that portion. As a measure of chalk is about

twice as heavy as a measure of coals, it follows that, ten pounds of coals are required to calcine 100 of carbonate, or one pound coals to 4.4 pounds carbonic acid; but as eighty-four pounds of the live coals would heat and evaporate twelve cubic feet of water, one pound of coals would heat and evaporate nine pounds of water. We thus find by rather a rough process, but from facts correct enough for general reasoning, because derived from operations conducted on the large scale, that the latent heat in carbonic acid gas, is about double the latent heat of steam.

If 37 parts hydrate of lime is placed in contact with 22 carbonic acid, the nine parts of water in the hydrate will be all expelled, and the carbonic gas combining in a solid form with the lime gives out its latent heat, which being taken up by the water, it escapes in the form of vapour, or steam of superior elasticity to the atmospheric pressure, although its temperature is insensible, this very curious or rather wonderful fact, and others, hitherto, I believe, wholly unnoticed, we shall see amply verified when we examine the properties of cements.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On the Production and Manufacture of Salad or Table Oil in the United States.*

The following remarks are intended to apply to that strip of the United States, which is comprehended between the latitudes of Cape Hatteras and Boston bay, extending westward.

Although there is no part of this extensive region in which the olive tree could be cultivated, except when protected by the green house, and therefore, the inhabitants are denied the advantages of this useful tree, it does not follow, that nature has denied them the means of procuring an excellent and pleasant substitute for olive oil, and one that could be brought into market at a moderate cost. Between them and this enjoyment, ignorance is at present a barrier, and in this case, as in many others, this is strengthened in its result, by prejudice.

In French Flanders, the farmers cultivate in large fields, and to a great extent the *White Poppy*. The seeds of this plant are collected and bruised in some way, and an oil expressed from them, which in all respects resembles olive oil, and is the source from whence is derived a large proportion of what is consumed in Paris. The poppy oil so much resembles olive oil, that strangers who visit Paris take it for that oil. These are facts as regards the consumption.

Of the state of this important branch of husbandry and manufacture, we the people of the United States know nothing. How is it cultivated, the seed collected, the oil preserved? Does the land require to be sown every year, or does it seed itself? What sort of a mill does it require? What is the product in oil, or in profit? In short, we have every thing to learn, except that, incidentally we have heard that fifty pounds of beet cake, after the sugar maker has got what he wants out of it, and ten pounds of poppy seed after the oil maker has done with it, will keep ten sheep a day and fatten them.

We know that since the article on beet sugar appeared in the Journal of the Franklin Institute, requesting those who knew any thing of the subject to favour the editor of the Journal or the public with information, a well

qualified agent has been sent to Europe to acquaint himself with the whole agricultural and manufacturing business that produces sugar.

On the present occasion, we invite the patrons of our country's industry and resources, to communicate for publication, what they know on the above interesting branch of French husbandry, &c. And we therefore request the wealthy and patriotic, to consider whether the case of oil does not resemble that of the sugar from the beet, and whether the best course would not be to adopt a plan similar to that which the friends of beet sugar have chosen.

The time will come when American parents will send their sons to Europe and to other foreign places, to learn the manufacture of beet sugar, of oil, and such other branches of the arts not possessed by us, in the same manner and with better reason that they now do to have them learn medicine and surgery:

June 4, 1836.

J. R.

## Civil Engineering.

*Some suggestions on the Location and Grading of Rail Roads.*

By THOMAS EARLE.

In the location and grading of rail roads, it is usual to reduce the road in all parts, as near to a level as possible, and in effecting this object, to make many curvatures, some of them of small radius. Thus, a very considerable increase of expenditure and of distance is occasioned, which appears to me inexpedient.

It is true, that if a rail road could be made perfectly level, or very nearly so, without being unreasonably curved, such a road would be better than an undulating one: because the locomotive engines would require to be transported less frequently over the ground, to convey a certain quantity of goods on such a road, although the expenditure of steam for conveying the train, independent of the locomotive, would be as great on the level road as on the undulating one. A perfectly level road, however, is impracticable in most parts of the country, except at an expense far exceeding the value of the benefit gained. Hence, it is probable that few roads will hereafter be made, without ascents and descents, in some parts, at the rate of forty to fifty feet per mile.

Such ascents being admitted in some parts of the road, the locomotives will take no greater trains than they can draw up those ascents. Hence, it will be useless to make excavations, embankments, and curvatures, to avoid other ascents of the same grade.

A locomotive will take a train up an ascent of twenty-one feet to the mile, and down a descent of the same length and grade, with precisely the same expenditure of steam, if it be constantly used, as would be required to take the same train over the same distance, on a perfect level. If the train were such as to require for drawing it on a level, a pressure of steam on the piston of thirty-six pounds to the inch, above the atmosphere, then on the ascent of twenty-one feet per mile, it would require sixty-three pounds per inch, and on the descent of the same grade, nine pounds per inch, making the average thirty-six pounds or the same as on the level.—Thus,  $63 + 7 = 72 \div 2 = 36$  pounds.

If, however, the road were composed of alternate ascents and descents, at the rate of from thirty to forty feet per mile, with but short levels between them, the engine would transport such train as it could draw on the road,

with a *less* expenditure of steam than it would require to transport the same train on a level. This might be effected by shutting off the steam from the piston on descents, and suffering the train to progress by its own gravity. The saving in this case, compared with the other, would arise from dispensing, on half the distance, with the amount of steam, viz: about fifteen pounds to the inch, which is required to overcome the external resistance of the atmosphere. There would also be a further saving from the constant use of high steam, if the supposed fact be correct, that a certain volume of steam under a pressure of one hundred pounds to the inch, can be produced with less than double the fuel which is required to produce the same volume of steam under a pressure of fifty pounds to the inch.

And the result, as to the expenditure of steam, will be equally favourable on ascents and descents, as great as fifty feet to the mile, (excepting the before-mentioned inconvenience of transporting the engine a greater number of times over the ground) as with ascents and descents of a less grade, provided the inclined planes be not so long as to require the checking of the velocity of the train, by artificial means in descending: for the momentum acquired in the descent, will continue the motion on the succeeding level or ascent, until the power expended in overcoming gravity in ascending, is reimbursed.

It is further to be observed, that if there be admitted on a road, inclined planes of several miles in length, and of a certain grade, *shorter* planes of a higher grade may be admitted on the same road, without inconvenience, because the momentum acquired by the velocity of the train, before commencing an ascent, will give considerable assistance in overcoming it. A velocity of twenty miles per hour would give a momentum, if I have estimated it rightly, sufficient to raise the train about twelve feet in perpendicular height. Thus a road having long inclined planes, graded at forty feet per mile, will admit those not exceeding two thirds of a mile in length graded at fifty feet, or not exceeding one third of a mile in length, at sixty feet.

Hence, it is unnecessary, on long inclined planes intended for locomotives, to make them of uniform ascent, as the momentum gained where the ascent is below the average, will assist in overcoming the resistance where it is above.

The making of curves in rail roads, to avoid slight ascents and descents, is productive of several inconveniencies.

1. It increases the cost of the road, by its greater length, and proportionably greater expenditure for land, foundation and rails.

2. By the increase of length, the time of travel and the expenditure of steam, is increased in nearly the same proportion.

3. The expenditure of steam is further increased, in overcoming the strain and friction occasioned by the operation of the wheels on the curves, the power expended not being re-imbursed, like that expended in overcoming ascents. The resistance on short curves upon a level is found to be greater than on a straight ascent of thirty feet per mile.

4. The wear of carriages and locomotives, and their liability to break or become disordered, is increased by the greater distance, and by the strain on the curves, which racks every part of the machinery to a degree much complained of by practical engineers.

5. The wear of the rails, and their liability to disorder is increased.

6. The danger of running off the road is increased.

Hence, a road should be made as straight as possible, without a great increase of expense, and without encountering ascents unreasonably great.

I will add a suggestion in relation to cars for burthen. The greater the load carried by each car, the less will be the weight and cost of cars, compared with the goods transported. Materials increase in strength in proportion to the cube of the diameter, while the weight and volume increase in proportion to the square. Hence, the cost of materials, workmanship, and transportation of cars, will all be reduced, by using as strong cars with as great loads as the road will permit. A further advantage in strong cars and heavy loads to each, will be found in shortening the train, and thus decreasing the strain in turning curves. As locomotive engines with six wheels are used, weighing with their water and fuel, eighteen or twenty thousand pounds, I can see no serious objection to the use of burthen cars of four wheels, weighing with their load, five and a half or six tons, with a proportionate increase of weight when six or eight wheels are used.

Objections have been made to the matter contained in the forepart of this essay: 1. That on an undulating road, the steam must be blown off and wasted on descents, owing to its superabundant quantity: 2. That although none were used on descents, the pressure of steam could not be kept up sufficiently, because none would pass through the flue to aid the draught. The two objections are contradictory of each other. They can both be obviated by proper power in the boiler, with an adequate steam chamber, and by proper attention to the supplies of fire and water. They are not felt as serious inconveniencies with the best engines on the Columbia Rail Road. There is one plane on that road of upwards of ten miles, and another of seven miles, where the cars will descend by their gravity. The engineers cause a fresh supply of water to be put in the boiler at the head of the plane, and no fuel till near the foot of it, and thus they avoid the necessity of blowing off steam. If they were to add fuel, they would have to discharge steam, which shows that both objections are of little importance, in comparison with the advantages of a straight road at a diminished expense.

If it should be found that without particular attention to the addition of water and fuel on descents of moderate length, where the train progresses by gravity, there will be an inconvenient surplus of steam, the difficulty can be obviated by the use of a damper to check the draught.

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## Physical Science.

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*Proposed forms of diagrams for exhibiting to the eye the results of a register of the direction of the wind.* By A. D. BACHE, Prof. Nat. Philos. and Chem., Univ. Penn.

My attention has been recently recalled to the subject of diagrams for showing the results of a register of the direction of the wind, by the first number of a meteorological publication,\* received through the politeness of its author, W. R. Birt, Esq. of London. At one of the early meetings of the joint committee of the American Philosophical Society and Franklin Institute, appointed in 1834, I laid before the members several plans for the purpose above referred to. These, I propose now to make public in the

\* *Tabulæ Anemologicæ*, or tables of the wind; exhibiting a new method of registering the direction of the wind, &c. &c. By W. R. Birt.

hope that one or other of them may prove acceptable to meteorologists. They exhibit to the eye the results of observations at the same or different places, thus facilitating the study of their connexion. One of the plans was considered preferable to the others by my colleagues of the committee, but as it may not be the most convenient under all circumstances, I have presented the varieties of the register as laid before the Committee. The scheme shown in fig. 4, plate 1, will be found to resemble in appearance that proposed by Mr. Birt; but the principle will be seen on examination to be entirely different from the one adopted by him.

The figures are placed in the order in which the methods suggested themselves. The first is probably the most natural form of diagram, and was the first which occurred to me, while the others are successive modifications growing out of difficulties, or objections, which appeared in studying the subject. The first was preferred by my colleagues of the committee as best accomplishing the object, while the last is adapted to the ordinary form of diagram used to represent the variations of the thermometer, barometer, &c.

A register of the wind should not only show its direction at the time of observation, but the direction through which it may have passed when changing from one point of the compass to another. A diagram illustrating such a register must admit of an easy mode of expressing the results, and the less artificial this method the better will it answer the purpose of addressing the eye. In his valuable meteorological essays Professor Daniell has adopted a method of representation first used, I believe by Mr. Howard. A horizontal line is drawn and points assumed upon it at convenient, equal distances, to represent the times of observation. Above this line points are assumed at regular intervals, to denote the points of the horizon between west and east, by the north. Supposing the cardinal and ordinal points only to be marked; the north west point will be on the left hand, and the east on the extreme right. The positions assumed for the points of the horizon will of course depend upon the degree of nicety to which it is intended to note the direction of the wind. From any one of these points to one of those in the horizontal line first assumed, representing the times of observation, a line being drawn represents the direction of the wind. A similar arrangement is made below the first horizontal line or at the foot of the diagram, if it is also to exhibit the state of the barometer, thermometer, &c., for the points from west to east, passing through the south. This method does not admit easily of expressing the direction through which a wind has changed, and the lines of direction of the wind, sometimes cross each other at such acute angles as to render it difficult to trace them. For example, when at the close of a month the wind is north westerly for several successive days, the lines expressing this fact cross the whole figure. They meet other lines sometimes quite obliquely, and being but slightly inclined to each other, the eye does not readily follow them. These remarks are not offered in the spirit of criticism, but merely to point out why I thought it advisable to obtain a different scheme of registry.

The ordinary method of representing the rise and fall of the thermometer or barometer, is a natural one; equidistant points on a horizontal line being taken to represent the times of observation and the perpendicular lines drawn through these points, or corresponding ordinates, being made proportional to the height of the column of mercury. In like manner the wind being registered with reference to the points of the horizon, the natural system of representing it is to assume a system of concentric circles the in-

tervals between which shall correspond to equal intervals between the times of observation, and the angular divisions upon which shall correspond to the rhumbs. Such a scheme is represented in figure 1, plate 1. In order to bring the figure within the compass of the page, it has been necessary to make it so small that it does not fully show the advantages of the plan. A diagram in which the outer circle is seven or eight inches in diameter admits of entire distinctness, when observations are not more frequent than four times during twenty-four hours, even at the season when the wind is most variable. Where observations are frequent, the interval between the concentric circles may conveniently represent a day, the first circle corresponding to twelve o'clock at night, on the last day of the preceding month, and the second to midnight of the first of the month, and so on. The observations at intermediate hours will be placed in their appropriate positions between the two circles just referred to, and the registry will be carried on in a similar manner throughout the month. In the case actually represented, fig. 1, plate 1, the regular observations were at 3 P. M. of each day, and I have drawn the concentric circles, represented by the finer lines, to correspond to this time. The intermediate observations when a change of wind required their use, have been placed within or without the several circles, according as they were made before or after 3 o'clock of the particular day to which the circle corresponds. The variable month of April has been selected for representation, as putting the diagram to a severe test. The circle having been divided as shown in the figure, so as to point out the cardinal or ordinal points, a dot is placed on that radius corresponding to the point from which the wind blows. Thus, on the 1st of April, 1836, at 3 P. M. the wind at Philadelphia was S. S. W. the dot numbered 1, is on the first circle recking from the centre, at the intersection of a radius, which would bisect the angle S-W. c. S. On the 2d at 3 P. M. the wind was N. W. a dot is therefore placed to denote this on the second circle, at the intersection of the radius N-W, c. The table from whence the direction of the wind was taken\* shows that the wind passed from the S. W. to the N. W. through the west as is expressed by the curve 1, 2, passing through the west point. On the 3d the wind was S. W. as denoted by the dot at 3, having passed back by the west, which direction therefore the curve 2, 3, is made to intersect. The wind passed the S. W. to S. S. W. between the 3d and 4th, as is shown by the curve 3, 4. It remained at this point until the morning of the 5th, as indicated by the straight line from 4, when it changed by the west to N. N. W. Passing this point to the north in the evening of the 5th, it returned to the N. W. on the 6th. It is hardly necessary to trace the courses further to show how the diagram represents the results of the table, but it is probably worth while to refer to one of the cases, when the change of the direction of the wind is not through the smaller angle between its two directions. On the 10th of April the wind was N. E. as indicated by the dot 10; on the 11th, it was N. W. having changed round by the South as fully represented in the curve 10, 11, which sweeps through the angle of  $270^{\circ}$ .

One objection occurs to the curves between the times of observation, namely, that they represent the wind as gradually changing, whereas, in fact it frequently ceases, an entire calm preceding the wind from the new direction. This false impression is entirely avoided in such a case, by a system of numbers, or symbols, representing the force of the wind. These

\* Kindly loaned to me for this purpose, by James P. Esq.

being placed in brackets, can not be mistaken for the numbers representing the days of the month, which it may generally be found convenient to place upon the points corresponding to the principal observation of the day. A curve being traced to a certain point, and found to terminate there a zero in brackets (0) will show a calm, and avoid this being taken for another case, which might occur in a defective register, namely, that in which the direction of the change was not noted. If the observations are frequent the curves will be traced entirely from them and will be of course, therefore, the more accurate, as the observations are more numerous. If there should be but one regular observation during the twenty-four hours, the direction in which changes take place being, however, noted, the dot will serve to point it out, and it will be easily understood that the curves merely show the angle of direction through which the change took place. The character of the weather may readily be entered on the diagram, which to accommodate such remarks should have its first circle farther from the centre *c*, than in the figure, the object of contracting which has been already stated.

Before I became familiar with the use of the first diagram, the considerable extent of the outer circles seemed to me quite objectionable and I therefore separated the monthly register into three parts as shown in figure 2. The left hand figure contains the observations of the first ten days, the middle figure of the next ten, and the right hand figure, of the last eleven days of the same month, which is registered in figure 1: The diagrams are strictly comparable as exhibiting the same results. The middle set of concentric circles is connected with the first by a dotted circle within that denoting the eleventh day of the month. On this circle, which corresponds with the tenth of the left hand figure, the observation marked on this latter is placed. Thus on the 10th the wind was N. E. as shown by the dot at the intersection of the radius N-E. *c*, on the outer circle of the left hand set. This mark is transferred to the dotted circle of the middle set and the curve traced between the dot and that, for the direction of the wind on the 11th, shows the angle through which the change from N. E. to N. W. took place. The concentric circles should commence with an inner one of more considerable diameter compared with the outer, than those on the plate, in order that the weather, clouds, &c. may be registered. The advantage of this mode of registry, or of illustrating a register in the easy comparison of results is in part lost by thus dividing the figures, an objection which led me to the scheme shown in figure 3.

A sector of a circle is taken, and similar arcs numbered I, II, III, &c. traced to denote the periods of observation. The central radius being assumed to indicate the north direction, the two extreme ones correspond to south. Proportional divisions of the angle between the lines S S', S S', give the other points of the horizon. In the figure a sector of 90° is taken, instead of the whole circle or 360°. This diagram represents the results of the same table which is illustrated by the other figures. Since there are two lines corresponding to a south direction, there are two corresponding points to be marked when the wind is south, or when it changes round by the south. Thus, on the 10th, at 3 P. M. the wind was N. E. as shown by the dot at 10 on the arc X, at the intersection of the radius N-E. *c*. On the 11th it was N. W. changing by the south through the E. &c. The curve passes across the E. and S. E. directions to the S, then from the corresponding point on the left hand line, S. S', across the S. W. and W. directions to

the N. W. This want of continuity is the only material difficulty in the use of the diagram. The system, however, is quite artificial.

By an easy transition the plan shown in figure 4, is derived from that just described. If an artificial system is to be resorted to, the convenience of using common ruled sheets employed for meteorological registers, would give it the preference.

Before describing this diagram, I propose briefly to state the means of representation adopted by Mr. Birt. This is done to show that the method now presented really differs from the one proposed by that gentleman, though in appearance resembling it. I assume, as a matter of course, that before deciding which of the two schemes would be preferable, the diagrams of Mr. Birt, to which I have before referred, and his own description, would be consulted.

A particular direction is assumed as that in which the greater number of winds at a certain place are found to blow, this, for London, is stated by Mr. Birt to be N. E. and S. W. This is called the anemonal direction, and a circle representing the horizon being divided by a diameter indicating this direction, the other rhumbs are denoted by their distances from this line. To construct a diagram for registry upon this principle, a line is drawn, representing the anemonal line, on which equal distances are laid off to correspond to equal intervals between the times of observation. Lines perpendicular to the anemonal direction are then drawn, on which to set off the ordinates representing the directions of the wind, according to the principle above stated. This amounts, in any case, to setting off a distance proportional to the sine of the angle which the direction of the particular wind makes with the anemonal direction. The assumed anemonal direction being N. W. and S. E. all winds from N. W. round by S. W. to S. E. are set off below the line of anemonal direction and all from N. W. round by N. E. to S. E. above the same line. But there are still two equal sines belonging to the opposite quadrants of each of these semi-circles, so that the same ordinate would represent a N. and an E. wind, or a W. and a S. one. To distinguish between these, the changes of wind from N. E. to S. W. by the N. W. are recorded by a single line, and those between the same points round by the S. E. by a double one. In practice, the ordinates are not laid off in the strict proportion of the sines, but after the points at  $45^\circ$  and at  $90^\circ$  from the anemonal direction have been thus fixed, the distances are divided into a convenient number of equal parts.

The table of Mr. Birt includes not only the register to which I have just alluded, but one of the upper current of air, as denoted by the motion of the clouds. A register of the clouds by a peculiar nomenclature devised by him, and a register of the weather by significant letters according to a system of Lieut. Becher. Although not relevant to the comparison in hand, I mention these points that there may be additional motives to consult the interesting document to which I refer.

According to my scheme in fig. 4, plate 1, the equal distances 1, 2; 2, 3; &c. correspond to equal intervals in the times of observation. The line N. N. represents the north direction, the lines S. S. and S. S. the south. The intermediate lines, at equal intervals, give the N. E., E. &c. and the N. W., W., &c. points. The observations being shown by dots, the lines joining these latter will denote the direction of changes. A south wind is recorded in the upper and lower lines S. S. as in the case of the 13th of April, shown on the diagram. A change of direction by the south

is similarly recorded, and renders the broken line joining the points registered, discontinuous. This case is shown between the 10th and 11th of the month, when the wind changed from N. E. to N. W. by the south. The eye soon becomes habituated to this form of diagram, artificial as it is, and can follow the directions of the wind in its changes, with considerable facility. The diagram, however, requires habit to render it acceptable, and I am not sure that the connexions are ever as well seized as by the first plan submitted. The extent of the diagram, to ensure distinctness, is quite inconsiderable, which is a recommendation. The record of the weather may be very conveniently made upon it, and as has been before remarked it may be formed on a sheet intended to trace the fluctuations of the heat, pressure, or moisture of the air, without any material change in the kind of diagram adapted to their registry.

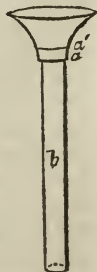
*Experiments on Endosmosis.* By JOHN W. DRAPER, M. D., Christiansville, Mecklenburg, Va

(CONTINUED FROM p. 182, Vol. XVII.)

17. The doctrine laid down in sections 13 and 14, of the condition of equilibrium of gases, on each side of a membrane, being the foundation of an explanation of all the phenomena which have as yet been noticed, require further consideration and fuller proof. Some remarks have been offered on the incompetent results which are obtained, by the use of barriers consisting of pores of large size, such as stucco plugs, sections 2, 3, 4. It is said however, that in the hands of Mr. Graham these have given some curious results, respecting the rate of diffusion of gases; experiments at once satisfactory and singular.

18. The objections above mentioned, have however, appeared to me so weighty, that I have not made use of such barriers, but resorted to liquids, which for closeness of texture, uniformity of composition, and above all, on account of our accurate knowledge of their habitudes and structure, are much preferable. They also, have given results as curious, but far more satisfactory, and though in the management of them something of that dexterity of manipulation is required which practice alone can confer, yet they are easy of repetition, never failing to give precise and comparable results. They also afford the means of prolonging or hastening the close of an experiment, which at times is invaluable; their action too, is very uniform, for a film of water so thin as to be coloured, acts as well as a mass several inches in depth, but the gases passing through it more rapidly a state of equilibrium on both sides of it is obtained in a few minutes. The following facts will serve as an illustration. Into a tube *b*,

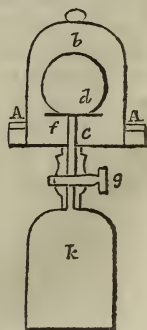
which was conoidal at its upper end, a disk of paper *a*, was fastened water tight, and then upon that was poured distilled water till it was about  $\frac{1}{8}$  inch deep, the tube was next filled at the pneumatic trough as in the figure with hydrogen gas, which passed into the atmosphere through the paper roof, and the water reposing on it; but though the tube was only  $\frac{3}{8}$  inch in diameter, twenty-four hours elapsed, before a column half an inch long of hydrogen, had gone out of it, and in seven days only one inch more. A common glass tumbler was filled with hydrogen gas, at the pneumatic trough, and by the side of it stood a small bottle, the height of which was about  $1\frac{3}{4}$  inch, its diameter  $1\frac{1}{4}$  inch, and the diameter of its neck  $\frac{3}{4}$  of an inch. The atmospheric air in this bottle, being of the same temperature as



the hydrogen in the tumbler, a finger dipped in water rendered slightly viscid with soap, was lightly passed over its mouth, so as to leave a thin film stretched there, the tumbler of hydrogen being placed over it, as in the figure. In the course of two minutes, the film, instead of being horizontal became convex, and continued to be so until it had swelled into a large spherical bubble, which capped the top of the bottle; in sixteen minutes this had increased so much in size and become so thin, that it was of a dark metallic lustre, and it burst at last by swelling, so as to touch the bottom of the tumbler. During this experiment, the barometer was at 28.8. Thermometer at 66.75. Fah.

19. The rapidity of this action being proportional to the thinness of the film used as a boundary, it is obvious that the duration of an experiment may be managed, by determining beforehand, the thickness of the film through which the gases shall pass. If very thick, the time may be indefinitely long, and if very thin, indefinitely short. Nor need we be limited in reducing the thickness to the greatest extent, for it is found by experiment, that however thin the film may be, it still possesses cohesion enough, and its parts are still so close, that any thing like mechanical straining or leakage cannot take place through it. The first attempts made to ascertain the laws of movement and equilibrium of gases passing through liquid films, were made by stretching those films over the mouths of phials, as here described; subsequently, for several considerations, this arrangement was given up, the horizontal film is at first too thick, it exposes too small a surface to the atmosphere to which it is subjected, and it is not until towards the close of the experiment, that the action becomes at all rapid. Bubbles of water made sufficiently adhesive by a little soap were therefore substituted. One of these filled with any gas, and immersed in an atmosphere of another gas at once exposes a large surface, and by swelling and collapsing allows a free action. There are, however, three circumstances which tend to destroy such bubbles, and against these provision should be carefully made. Mechanical agitations of the surrounding air may be met, by covering the whole arrangement with a glass bell. Evaporation from the surface of the bubble, which reduces its substance unduly, may be avoided by keeping all the gases under trial, in jars over water, until they are loaded with moisture, and thoroughly wetting the inside of the covering bell; but it is not so easy to prevent that slow motion of the parts of the bubble, which in virtue of the earth's attraction, tends gradually to bring them to the lowest part whilst the walls of it become too thin to bear the weight, and are liable to burst by the expansion of the gases accumulating within.

20. After a number of trials, the following has been found to be the most suitable arrangement for prosecuting these enquiries; it is simple, not easily deranged, and allows of sufficient latitude and change, to suit other experiments. In it a soap bubble may be preserved with certainty, for a time considerably exceeding an hour, and sometimes much longer. As here described, it was used to illustrate the relative passage of hydrogen, oxygen, and nitrogen, through a watery film into atmospheric air. It is represented in section, A A is a small tin saucer, about three inches in diameter and half an inch deep, into it water can be poured, and it also serves as a platform to support a large cupping glass *b*. Through the centre of this tin saucer at *c*, passes a glass pipe *f*,  $\frac{1}{8}$  inch in diameter, the upper extremity of which is cemented into a



hole of the same size in a round, thin, piece of copper *d*, which is about half an inch in diameter, the other extremity of the pipe opening into another cupping glass *k*, through a perforation in its top, the communication being capable of being cut off, by means of a cock *g*, the lower cupping glass serves as a support to the whole arrangement when placed upon the shelf of the pneumatic trough. This apparatus is used as follows: The upper cupping glass being taken off the platform, is filled with any gas under trial, as oxygen, and placed aside on the shelf. The lower cupping glass is then filled with water, by depressing it in the trough, and the cock being closed, five hundred measures of hydrogen for instance, are thrown into it. After seeing that the copper plate *d*, is free from moisture, a drop of water rendered slightly viscid by soap is placed upon it, exactly over, where the orifice of the pipe *f* opens. The upper glass containing the oxygen, is now placed upon the little tin saucer platform, as in the figure. The lower glass is next depressed in the trough, and as soon as the cock is opened, a bubble of hydrogen containing five hundred measures expands, the spare oxygen escaping in bubbles from the upper glass, through the water in the saucer, the cock is next closed, and the apparatus placed on the trough shelf, as long as the operator desires the experiment to continue. Keeping that position when the cock is once more open, the gas passes into the lower glass, until the bubble is entirely collapsed, when the cock is again closed, the contents of the bubble being now ready for measurement, or analysis. As the gas passes from the bubble into the lower jar, the water rises from the tin saucer into the cupping glass above, confining the gas that was outside of the bubble; this, by the common mode of manipulation, is to be transferred from the tin platform to the shelf of the trough for inspection.

21. By this apparatus it was found, that one thousand measures of atmospheric air, exposed in a bubble to atmospheric air, in five successive experiments, underwent no change either in volume or composition. The duration of the trials was severally, ten, fifteen, twenty, thirty and sixty minutes, and the uniform result when drawn back into the under cupping glass was one thousand measures exactly, the composition of which was the same as atmospheric air.

22. The thermometer stood at 54° Fah. One thousand measures of hydrogen in the watery film, were subjected to atmospheric air in the upper bell; in five minutes there remained only four hundred and seventy-two. In a second trial, one thousand measures in twenty minutes, became four hundred and thirty-two; and in a third, when the same quantity of gas was confined half an hour, the residue was four hundred and eighty measures.

23. A reverse action ensues, when nitrogen is substituted for hydrogen, the bubble swells, instead of diminishing and the resulting gas measures more. It is to be remarked that after the first five minutes, provided the bubble has been sufficiently thin, there appears to be little or no change in the volume of gas, and in a great many experiments it was found, that motion had ceased when the bubble had increased somewhere between  $7\frac{1}{2}$  and 10 per cent. The thermometer standing at 55° Fah. one hundred measures of nitrogen in half an hour became one hundred and seven and a half. In another trial, two hundred measures in the same time, became two hundred and fifteen. Again, two hundred in fifteen minutes, became two hundred and sixteen. The greatest variation from this was in one case, when after an exposure of five hundred measures for five minutes, the bubble was

found to contain five hundred and forty-five measures, or an increase of 9 per cent.

24. Oxygen gas exposed in like manner to atmospheric air, decreased in bulk; thus two hundred and fifty measures in ten minutes, became one hundred and fifty-three, and the like quantity in fifteen minutes, diminished to one hundred and forty-four, which amply proves that the passage of oxygen takes place through water, more rapidly than nitrogen. And upon this fundamental principle, chemical decompositions can be effected; as in the last section, where we have a bubble of nitrogen gas exposed to the atmosphere, the nitrogen outside parts with its oxygen, which, passing through the barrier, unites with the oxygen within.

25. Having thus recognised a variation in the rate of passage of gases through thin films, it becomes a point of investigation, to ascertain how long these motions will be maintained, and under what circumstances a state of equilibrium will ensue. I have already stated, that the condition of rest was simply an identity of composition of the media on both sides the membrane, a law which is rigidly observed by all gases that have yet been tried. Four hundred measures of nitrogen gas, procured by phosphorus, but which by standing over water were found to have gained  $3\frac{1}{2}$  per cent. of oxygen were exposed to atmospheric air, in the apparatus above described, for thirty minutes, at the end of that time, there were found four hundred and thirty-two measures in the bubble, of which  $15\frac{1}{2}$  per cent. were oxygen. Outside the bubble were ten hundred and seventy measures, which also contained  $15\frac{1}{2}$  per cent. of oxygen; thermometer  $57^{\circ}$  Fah.

26. Two hundred measures of nitrogen, containing the impurity as above, were exposed for thirty minutes in an atmosphere of impure oxygen, which contained nitrogen and carbonic acid, to the amount of  $13\frac{1}{2}$  per cent. At the end of that time, three hundred and sixty-one and a fourth measures were found in the bubble, of which 62 per cent. were oxygen; and eleven hundred and forty-four and a half measures were found outside,  $62\frac{1}{2}$  per cent. of which were oxygen; thermometer  $55^{\circ}$  Fah.

27. Two hundred measures of oxygen were exposed to an atmosphere of hydrogen for fifteen minutes, at a temperature of  $66^{\circ}$  Fah. at the end of that time, two hundred and seven and three fourths were found in the bubble, containing  $16\frac{3}{4}$  per cent. of oxygen, and twelve hundred and seventy-three outside, which also contained  $16\frac{3}{4}$  per cent. of oxygen.

28. The slower passing gases being thus found to obey a very simple law of equilibrium, attempts were made to ascertain whether such, as carbonic acid, which are very absorbable by water, followed the same law; but after many trials no certain result could be obtained, so rapid was the action. Five hundred measures thus confined, passed out immediately, the bubble collapsing almost as fast as it had been expanded, a tube was therefore prepared, which had a roof of water at one extremity, about half an inch thick and two inches in diameter; beneath this roof five thousand measures of carbonic acid gas were placed, and the arrangement exposed to the atmosphere. In forty-eight hours analysis showed that a trace of carbonic acid still existed in the tube, which when washed off, about two hundred measures of unabsorbable gas remained, consisting of 20.5 oxygen, 79.5 nitrogen; and therefore, atmospheric air. This experiment would thus warrant the conclusion, that gases of any kind will pass a barrier, subject to the same regulations as those that are less absorbable, had this experiment been allowed to continue for a sufficient length of time, there can be no doubt that all the carbonic

acid gas present, would have escaped into the atmosphere, and atmospheric air alone been present on both sides of the barrier.

29. Hence the condition under which motion ceases through a barrier, is identity of chemical composition on both its sides. As gases however, pass with different degrees of velocity through the same liquid, results seemingly anomalous may be obtained, and chemical decomposition may ensue; if water recently boiled, be exposed to the atmosphere, it will be found in a few hours, to have abstracted oxygen and nitrogen gases from it, not in the same proportion, however, that exists in the circumambient air, for the gas found in water contains  $\frac{1}{3}$  instead of  $\frac{1}{4}$  of oxygen; perhaps in the course of time that richer gas would escape, and its place be taken by common air. We therefore consider this a case in which equilibrium has not ensued, progress only being made toward it, the decomposition and apparent anomaly being only the result of a more ready solubility and rapid passage of one gas. By taking advantage of this, it is possible to obtain from the atmosphere, oxygen of some purity. If a volume of atmospheric air be agitated with boiled water in a close vessel, it will be found that a rapid absorption of its oxygen ensues, whilst but little nitrogen is imprisoned among the pores of the liquid. This gas, by the action of fire, may be driven off from the water, and being subjected to another washing, may be rendered still more pure, by successively washing and rejecting the nitrogen left, a gas so rich in oxygen may be procured, as to be equal to some that is obtained by other processes, as by the action of sulphuric acid on peroxide of manganese. In like manner nitrogen gas of great purity may be obtained, by the action of masses of charcoal. Into five hundred measures of atmospheric air, a piece of charcoal was placed, which had been made red hot and quenched under mercury, without being allowed subsequently to come into contact with the air; in a short time the gas was found to be much reduced in volume, and ultimately there remained two hundred and five measures unabsorbed, containing only 8 per cent. of oxygen. The piece of charcoal being removed into water, gas was rapidly evolved which contained only 3.75 per cent. of oxygen, and the last portions disengaged only 2.8 per cent.

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## Franklin Institute.

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### *Monthly Conversation Meeting for April.*

The Eighth Monthly Conversation Meeting of the season was held at the Hall of the Institute, on the 28th of April.

Mr. George Hallows, of Miamiville, Ohio, exhibited a working model of a press for moulding bricks, together with a sample of the manufactured article, the latter very perfect in its form.

Mr. Franklin Peale explained the construction and operation of a machine for counting specie by means of which one person can arrange in uniform piles several thousand coins in a minute.

Messrs. Curtis and Hand exhibited some very neat samples of Carpenter's rules and Norfolk latches, the former manufactured by Clark & Co., of Brattleboro' Vermont, the latter by Isbell Curtis & Co. Meriden, Conn.

Messrs. H. B. Hall & Co., presented samples of improved patent Razor Strap, manufactured by E. M. Pomeroy, of Wallingford, Connecticut, which are found upon trial to be of superior quality.

## COMMITTEE ON SCIENCE AND THE ARTS.

*Report on Mr. Abraham Gregg's Steam Boiler.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Steam Boiler, invented by Mr. Abraham Gregg, of Warsaw, Genesee County, New York, REPORT:—

That having examined the model and specification of Mr. Gregg, they find the objects proposed by the inventor to be the exposing of large surfaces of metal to the action of the fire, compared with the quantity of water used; and the facility of getting at the interior for the purpose of cleansing the boiler.

The method by which he has proposed to effect the former object is, instead of employing a single cylindrical flue or several pipes to convey the gas through the boiler as in well known forms of steam boilers now in use, to form two concentric flues, the inner one a perfect cylinder, and the outer one having the upper portion suppressed in order to leave room for the escape of that portion of steam which may be generated between the inner and the outer flue.

It is proposed to place the fire beneath the boiler, to act on its inferior surface, that the hot air may return through the outer flue and entering the inner one, pass a third time along the length of the boiler and be discharged into the chimney.

To attain his second object, Mr. Gregg makes only the outer shell of his boiler a fixture, and all those cylinders, or partial cylinders, which constitute the concentric flues and their intermediate spaces, he makes *movable*, so as to be drawn out of each other and out of the exterior shell, somewhat after the manner of the concentric tubes in an optic glass. The spaces for water are left by means of rings, of which eight are used in the construction of this boiler, placed on the inside and riveted near the end of each exterior cylinder, which is to retain the water on the outside of the interior cylinder, which is to come next in the order. Thus each head of Mr. Gregg's boiler instead of a single solid piece of cast iron or other material, is made to consist of four concentric rings in two pairs, forming between each pair a circular joint, necessary to be rendered steam-tight, and giving two distinct water chambers only connected with each other at their upper parts where the outside concentric *flue* is interrupted for the purpose of affording a passage to the steam from the interior water chamber to the induction pipe of the engine.

The committee do not deem it necessary to enter into a detail of the manner in which it is proposed to connect the several concentric parts of this boiler together, as they are satisfied that both the objects proposed are quite as well, if not better, effected by the tubular boilers in common use than by the method above described.

They consider as wholly inadmissible, at least on a large scale, the system of loose joints in the head of a boiler, and they deem the arrangement by which the water in two separate parts of the chamber is kept from direct liquid communication to be fraught with danger whenever the water from any cause becomes low in the boiler.

The difficulty of maintaining an equable temperature throughout the system of concentric cylinders must, they apprehend, be found a most serious obstacle to the preservation of steam joints in the double rings. The delay in cleaning boilers, even when it can be done by simply entering them and

scraping out the sediment, is often of serious disadvantage; but when the joints are to be unpacked, heavy cylinders, often of many tons in weight, to be withdrawn, and after cleansing, restored to their places and the packing renewed, we cannot suppose that any difference in the cleansing will compensate for the complicated operations necessary to be performed in the present instance.

We are, on the contrary, constrained to believe that the fire surface will be less, and the trouble of cleansing greater, than in the common boiler; to which is added the danger above referred to against which they find no provision in the specification, or the model of Mr. Gregg.

By order of the committee.

February 11, 1836.

WILLIAM HAMILTON, *Actuary.*

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*Report on Mr. William Shultz's Spark Arrester.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Spark Arrester, invented by Mr. William Shultz, of Philadelphia, REPORT:—

That they have examined the plan of Mr. Shultz for arresting the sparks from locomotive engines and that its principal features and mode of operation are as follows:

As in most other contrivances for this purpose the one now before the committee resorts to the use of the wire gauze for intercepting the sparks.

But instead of having it on the top of the chimney in the form of a bonnet or cap, it is interposed in a horizontal plane near the bottom—a conical enlargement in the chimney being provided at that place to allow a sufficiently extended surface for a free passage of the smoke and heated air.

A small door in the side just above the gauze commands a view of the whole surface of the gauze for the purpose of cleaning, &c. The advantages of this arrangement are evidently three fold. First, in admitting the escape steam to be discharged above the gauze by the pipe passing through it in the middle, thereby avoiding the serious inconvenience of the meshes becoming choked by the combined effect of soot and moisture, which is felt, when the steam is discharged below it. Secondly, in a better disposition of the weight of the apparatus which in the ordinary mode makes the chimney top heavy—and thirdly, in having all within convenient reach of the engineer. Besides the main, there are three considerable flues which are occasionally opened by slides which draw horizontally for that purpose. These flues are on different sides of the chimney passing outside of the sheet, or disk, of gauze and serve to give additional freedom to the passage of heated air and smoke, whilst the fire is starting. In an apparatus of this kind which the inventor stated had been tried on the Germantown road, the enlarged diameter of the chimney was three feet in the clear whilst that of the chimney proper was of the usual size of fifteen inches. The inventor likewise stated to the committee that the experiment was entirely successful so far as a single trial could be depended on. The committee are aware that the principle of placing the gauze below the point at which the escape steam is discharged has been before attempted by putting it in the smoke chamber. The objection to this plan seems to have been a too rapid destruction of the gauze by the heat to which it was exposed—a fate which it is feared in some degree awaits the present invention. But from the facility with which the

gauze can be replaced by removing the upper section of the chimney, the opinion is entertained that this will be found the best arrangement which has yet come to the knowledge of the committee for the accomplishment of this difficult desideratum.

By order of the committee.

March 11, 1836.

WILLIAM HAMILTON, *Actuary.*

*Mr. Fossard's Manufacture of Prussiates and their application to Dyeing.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, Mr. Felix Fossard's manufacture of Prussiates and their application to Dyeing, REPORT:—

That Mr. Fossard submitted to the committee an apparatus and process for the manufacture of the prussiates of potash and soda, and for dyeing with these salts.

The great improvement in the manufacture of the prussiates is in not subjecting the materials to a higher heat than that which is required to produce these salts. This is effected by a mechanical arrangement which brings every part of the material by turns in contact with the heated sides of the vessel, containing the articles from the calcination of which the prussiate results. Particular directions are given in the specification of Mr. Fossard's patent, as to the proportions of the materials, and the best mode of conducting the whole process, from the mixture of the animal matters and the potash, or soda, to the crystallization of the ferro-prussiate. The apparatus seems well adapted to its purpose. While the committee consider it unnecessary to describe the different parts, they must, in passing, observe, that the ammoniacal, or other incidental, product of the action of heat on the animal matter, are collected to be turned to account by the manufacturer.

Mr. Fossard exhibited to the committee some documents founded on the practice of his process in England, where it is also patented, and going to show considerable gain over the common method of manufacture. He also showed beautiful specimens of crystallized ferro-prussiate of potash, manufactured by this process at Stratford in England.

The committee further examined a drawing of the apparatus for dyeing blue, with the prussiate of potash and a per salt of iron, with specimens of cloths and wool dyed by the process. The dye is proposed to be substituted for indigo, particularly for dyeing coarse cloths or wool.

The cloths are dyed in the piece, and being subjected to pressure during the operation, the dye perfectly penetrates the whole thickness. Mr. Fossard has succeeded in entirely removing the harshness usually produced in the cloth by the prussiate dyeing. The varieties of shade in the specimens of cloth examined by the committee, range from light blue to black.

The committee are not prepared to say that the blue upon the fine cloths had all the richness of an indigo blue, but it is said to wear much better than the latter dye, and the seams of a cloth coat, almost thread bare, showed no whiteness. On this point the patentee submitted testimonials from respectable gentlemen known to the committee, and who had worn cloth dyed by this process. The advantage of this dye will, however, be most perceived in the coarse cloths, where the item of dyeing is a considerable one in the cost of the cloth.

The committee have particularly examined the point, whether the colour imparted to cloth in this process is entirely permanent. They have satisfied

themselves that when due care is taken in washing the cloth, there is nothing which will subsequently be removed by rubbing, or by water. They have also had the testimony of a gentleman well known to them, and who has worn a coat dyed by this process, that no exposure to weather has ever removed any part of the colour, nor has any soil appeared imparted by the cloth, when wet or dry, to the clothing with which it has been in contact. This objection then applies only to careless or defective manipulation, and is by no means a necessary consequence of the use of this dye.

By order of the committee,  
May 12, 1836.

WILLIAM HAMILTON, *Actuary.*

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## Mechanics' Register.

### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1835.

*With Remarks and Exemplifications by the Editor.*

1. For a *Hot Air and Cupola Furnace*; Leonidas V. Badger, Portsmouth, Rockingham county, New Hampshire, December 2.

This cupola furnace is to be in the usual form, and the upper part of it, above the brick lining, is to have concentric metallic cylinders, or rather truncated cones, standing four inches apart; the inner cone, at its lower end, being of the same diameter with the brick lining of the furnace body, so that the interior may be in a continuous line from top to bottom. A spiral partition is to run round within the space between the upper cones, leaving a distance of four inches between the coils, thus constituting a circuitous pipe of four inches square. Into the upper opening of this, the pipe from the bellows is to enter, and from the lower part pipes are to proceed down so as to conduct the heated air into chests, or boxes from which the tuyeres open into the furnace.

The body of the furnace, surrounding the brick lining, is likewise to be a double case, with an inch space between them.

The claim is to "the double cylinder at the top of the furnace, forming a circuitous chamber for the air, heating the blast from the flame of the furnace, thereby causing a great saving of fuel and time. Also, I claim the double cylinder to the body of the furnace, preventing the escape of heat by the confined air between the two cylinders."

Various plans analogous to the foregoing, for heating air in cupola furnaces, have been carried into operation both here and in Europe. Of some of them we have particular accounts, of others nothing more than general descriptions; and how far the patentee has been anticipated in his particular mode of effecting his purpose we are not prepared to say. The second part of his claim we think ought to have been omitted, as a double case, with air confined between, to prevent the dissipation of heat, is an arrangement familiar to every man of practical science.

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2. For an improvement in the *Composition of matter, and a Machine for Manufacturing Crayon and Pencil Points*; Guy C. Baldwin, Ticonderoga, Essex county, New York, December 2.

For this composition we are told to take equal quantities of rosin and pitch, with as much shellac as is necessary for strength, and to add to them

"finely pulverized black lead, of sufficient quantity, when melted, to form a soft paste;" then to expose the mixture to a melting heat, and to stir it with a trowel until it becomes soft and yielding. The composition is then to be put into a heated iron mould, and forced through one or more holes of any size required, when it is in a proper form for rolling, by which it acquires a polished surface. The rolls are then to be laid in a straight position, cooled, gauged, and cut into the required lengths.

The foregoing information is succeeded by a "description of the machine," which includes the trowel, the knife, the rubbing board, &c. &c. all of which, of course, are patented, as there is no discrimination between them, nor any thing which can be construed into a claim.

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3. For *Smoothing the Oxide of Iron, Brass, &c.*; Bradford Seymour, Oneida, Utica county, New York, December 2.

We are first instructed how to produce an oxide on the surface of metals, which is to be effected by heating them by any proper means. This oxide is then to be smoothed by holding the surface of the metal against a brush of wire, which may be cylindrical, or of any other suitable shape. We are in conclusion told "that this machine and art is intended to be applied to the manufacturing of an article of sheet iron, similar to the article known as Russia sheet iron."

There is no claim made, and if such a brush had been claimed the claim would have been invalid. Such "scratch brushes" have been used in the lathe for ages, and are well known to workmen; but had the thing been new, the information furnished by the patentee would have fallen far short of fulfilling the requirements of the law.

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4. For *Wheels for Rail Road Cars*; Arundius Tiers, Kensington, Philadelphia county, Pennsylvania, December 2. (See specification.)

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5. For an improvement in *Raising Sunken Vessels*; William Atkinson, and Ebenezer Hale, city of New York, December 2. (See specification.)

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6. For *Water Proof Boots and Shoes*; David Clarkson, city of New York; an alien who has declared his intention to become a citizen of the United States; December 2.

"The improvement for which I solicit letters patent, consists in having a lining to the boot or shoe composed of camel's hair, and lamb's wool, covered with gum shellac and alcohol. The lining is made over the block in the shape of the boot or shoe, then the gum shellac and alcohol are spread over with a brush, and worked in with a hot iron, after which the boot or shoe is formed over the lining in the usual manner, except that the tacks in the bottom are omitted."

It is a common practice to render hats water proof by means of shellac varnish, and the foregoing patent is for applying a similar covering to the feet, but as the patentee uses a lining of camel's hair and lamb's wool, we are at liberty to employ sheep's wool, rabbit's fur, &c. &c. without interfering with his *exclusive privilege*. For ourselves, however, we have no disposition to adopt the one or the other, as either, by confining the perspiration which ought to escape freely, would produce results not only offensive, but injurious.

7. For a *Brake for the Wheels of Cars and other Carriages*; John R. Smith, Port Clinton, Schuylkill county, Pennsylvania, December 2.

This patent is taken for a self-acting brake, and the subject is treated as though such a contrivance had not previously entered into the head of any one. So confident is the patentee of this that he says "I do not deem it necessary to describe very minutely any particular apparatus, as it must vary according to the construction of the car." It will be found, however, that the law requires such a minute description, although it does not compel the patentee to abide literally, but only substantially, by it. The claim is to "*the principle of acting upon brakes by the contact and motion of the cars, by impeding, or stopping, the propelling power.*" Now the law does not grant patents for principles, but only for the means by which principles are carried into effect, yet all the information derived from the specification, on this point, is that the apparatus by which the cars are coupled is to be connected by rods, bars, or other contrivances, passing under the cars, and acting upon brakes, when brought into contact by the impeding of the locomotives, or from any other cause. We are also informed as regards common road carriages, that "any fixture on them to produce friction on the wheels, by the tendency carriages have to press forward on the horses, when descending hills, I should deem an invasion of my rights." Were such really the case, the patent law, instead of "promoting the useful arts," would become the means of putting a stop to all further improvement in the means of accomplishing any object which had been previously effected in any way.

8. For a *Machine for Drilling Rocks*; Aaron H. Vancleve, Stonington, New London county, Connecticut, December 2.

Drills are to be made to slide up and down in a frame adapted to the purpose, and are to be raised by cams upon a horizontal shaft, which is made to revolve by hand. In vol. v, p. 290, of this Journal, a similar machine is described, which was patented by J. W. and C. Post. This machine was made and tried, but was not found to answer the purpose intended; in the one now presented, there is not, any thing to insure its better action. The claim is to "*the above described machine, and the arrangement and adaptation of its various parts.*"

9. For an improvement in the method of *Making Cast Iron Pipes*; John D. Morris, Kensington, Philadelphia county, Pennsylvania, December 2.

An iron mould is to be made in two pieces, the interior of which has the form intended to be given to the outside of the pipe, and in this respect, resembling the two sides of a flask in which a pipe has been moulded. The core is to be made and managed in the same way as when the pipe is cast in sand. Upon the lower half of the mould there is a lengthening out of one end to sustain a piece for the gate, and sinking head. It is proposed, sometimes to line the mould with a composition of fire clay and sand, provision being made, in this case, for properly forming and smoothing the surface; a groove on the edges of the mould is also to be filled with clay and sand, to cause them to fit closely together.

The claim is to "*the two cast-iron pieces as above described, and also the using of a cast-iron mould to be coated over as aforesaid, within which pipes or other castings may be cast without injury to the mould, which will therefore last for a considerable length of time, and from which a great*

many castings may be made, without requiring, as in the common method, an entire new mould in every instance."

10. For a *Revolving Cooking Stove*; Henry Stanley, Poultney, Rutland county, Vermont. First patented December 17, 1832. Patent surrendered, and re-issued December 2.

This cooking stove is too well known to need any description, and the decision of the United States Court which led to the surrender of the original patent was published at p. 165 of the last volume of this Journal. The following is the conclusion of the new specification.

"I do not claim the revolving of the top abstractedly, nor any one part of the above described stove, as my invention, separately, and independently of the combination herein claimed; but I do claim as my invention and improvement, the combination of the above described cap, or top plate, in connection with its revolution, and its position in relation to, and resting upon, the circular plate on which it revolves, and the rack or pinion, or other power used to cause the revolution, and the groove and flanch on which, and the centre round which, the cap or top plate turns, and the collars and flues connected as they are with the position of the plates, the fire room and diving flue, as they stand combined and connected with each other in the manner above described, and exhibited in the drawings, or in any other manner substantially the same, and as the whole combination stands connected with the other parts of said stove."

11. For *Weaving Stock Frames*; F. Goodelle and Thomas W. Harvey, Ramapo, Dutchess county, New York, December 2.

These stock frames are to be woven in a power loom, constructed for the purpose. The apparatus is necessarily complex, and does not admit of verbal description. The patent is accompanied by a very perfect engraved representation of it with numerous references. After describing the apparatus, the patentees make seven distinct claims, to those parts of the apparatus by which the loom is adapted to the special purpose to which it is to be applied. Were we to give these claims they would not afford any correct idea of the particular construction of the things claimed; upon a careful examination of them we do not find any thing which does not appear new in the manner, and for the purpose, to which it is applied.

12. For a *Machine for Hulling Clover and other Seeds*; George W. Taylor, Bridgeton, Cumberland county, New Jersey, December 4.

The rubbing is to be effected by revolving, cast-iron disks, the surfaces of which are convex, so that they are in shape like a double convex lens; the surfaces having grooves formed upon them, and which revolve between cast iron cheeks furrowed in like manner, and embrace about two-thirds of the disks, the other third being cut away to allow of the necessary space for the feeding and delivery of the seed. There is to be a feeding hopper above the revolving disks, and other necessary appendages. The claim is to the machine as described.

13. For a *Cook Stove*; Bennington Gill, city of New York, December 9.

This stove is intended principally for the purpose of cooking by means of anthracite, but the fire place may be so constructed as to burn wood, if de-

sired. The bottom plate is to be circular, to stand on feet, and to sustain a square box for the ash pit drawer. Above this is the fire place, which is made conical, its lower end being about seven inches in diameter, its upper about twelve, and its height about seven. This is surmounted by what is called the receiver, consisting of a circular plate fitting on the upper edge of the fire place, having another five inches above it, forming the two, with their rim, a flat cylinder which receives the lower parts of the cooking utensils through openings in the top plate. A plate within the receiver, over the fire, serves to distribute the heat laterally, and there are sliding valves, or dampers, to direct it under any particular vessel. The claim made is to the arrangement of the respective valves, &c. within the receivers. The difference between this stove and some which have been previously made is not very great, and so far as we can judge from the description and drawings, which are by no means defective, we should much prefer one of Stanley's rotary stoves to it, as being less complex, and more convenient.

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14. For a *Machine for Cutting Straw, and Thrashing and Winnowing Grain*; Leonard Marsh, Hartford, Windsor county, Vermont, December 9.

This is a combined machine intended, in general, to cut the straw into lengths, like an ordinary straw cutter, and to thrash the grain from it, after which the grain and straw are to be separated by winnowing, in the usual way. When the grain is to be thrashed only, the cutting knives are to be removed, the thrashing part remaining, to effect that object.

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15. For a *Gentleman's Travelling Dress Hat*; Victor De Braine, city of New York, December 9.

This is to be a kind of hat the crown of which may be flattened down, its sides folding in like the leather of a pair of bellows. A thin metallic hoop is to surround the interior of the crown at its upper, and another at its lower part, and these are to be connected together by hinges, of thin steel, having a joint in the middle, and at its attachment to each hoop. These hinges fold inwards when the crown is depressed. An intermediate hoop is also employed to increase and regulate the fold. The claim is to the particular arrangement described.

It is unfortunate for the American inventor of this hat, that precisely such hats were made and sold in Paris, at least as far back as the year 1833, at which time a friend of ours bought one in the "Place des Victoires," in that city. It is rather too late, therefore, to re-invent the thing in New York.

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16. For an improvement in the *Truss for the cure of relaxation of the Vagina, and prolapsus of the Uterus*; patented by Amos G. Hull, May 7, 1834. John F. Gray, administrator of the estate of Amos G. Hull, December 15.

The description of the improvements made by Mr. Hull in the above named truss, as given by his administrator, is not of a nature to be made known without the drawings which accompany it; we therefore pass it over.

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17. For a *Fire-place and Grate for burning wood or coal*; Charles Lane, Hingham, Plymouth county, Massachusetts, December 15.

The lower bars of this grate are to be set below the level of the hearth, and the air to feed it is to be admitted from without, through an opening regulated by a valve, or dampers. The jambs and back are to form hot air chambers, from which the heated air is to be distributed through tubes; vessels for water are also to be contained within the jambs, the vapour from which is to pass into the room through tubes. There are five distinct claims made, which we do not think it necessary to copy, as they contain little if any thing that is new; let one serve as a sample, "the generators of hot air, and the mode of transmitting it to the room." The whole description is of that general character which does not fulfil the requirements of the patent law; and were this defect cured, most of the things claimed would be found untenable.

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18. For an improvement in the *Machine for Pressing and delivering Bricks*; Ulysses Ward, Washington city, December 15.

This patent is obtained for an improvement upon the brick machine patented by Nathan Sawyer, on the 8th April, 1835, which it is proposed to simplify by dispensing with the combination of wheels for conveying the power to the press, and by certain alterations in the apparatus by which the pressed brick is delivered. These alterations, or improvements, could not be clearly described without the drawings; we are informed that the improvements, are really such, as they have been carried into operation, fairly tested and compared with the original machine.

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19. For a *Spiral Bolt, for Bolting Meal and Flour*; Aretus A. Wilder, Mount Morris, Livingston county, New York, December 15.

A spiral thread is to extend from end to end of the bolt, and from the shaft to the bolting cloth. Upon the outer edge of this thread there is a strip of tough hard wood, to which the bolting cloth is to be nailed; and at the ends the cloth is to be fastened by being received between iron hoops screwed together. The advantages of the spiral thread are set forth as though this was new, but care is taken not to include it in the claim, which is to "the frame, or reel, round which the bolting cloth is put, and the fastenings at the ends." This claim is rather obscure, as the frame or reel would include the whole, a claim which cannot be sustained. As to the "fastening at the ends," any workman, who was at a loss to devise means equally good, without interfering with the present patentee, would not be a *don* at his business.

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20. For a *Machine for cutting or splitting Laths*; Barnabus Langton, Troy, New York, December 15.

A horizontal bench, or frame, is to be made, which may be sixteen feet long and seven wide; and at each end of this there is to be a head-block, against which the laths are to be cut. The cutting is to be made from the edges of boards, sawed of a proper length, there being two cutting knives at each end of the frame. These cutting knives meet in the middle of the board, as the lath is cut, their outer ends working on pins attached to the head-block or frame, and their inner ends on similar pins connected with a sliding bar extending along the middle, and from one end of the frame to the other. The sliding bar is worked backward and forward, horizontally, by a crank motion, so that when the knives at one end are cutting a lath, those at the other are being withdrawn to allow the board to descend

for a new cut. The pieces of board are passed into a slot edgewise, at either end of the frame, and descend by their own gravity, or to a gauge which determines the thickness of the lath. It is proposed sometimes to use a single knife at each end, which knife must in that case, be the whole length of the lath.

The claim made "in the above described machine, is the machine itself, and the manner of cutting lath above specified and described."

Such a claim, we apprehend, must be understood to include not only the combination, but also the several parts as described; in which case it is much too broad, as the cutting of laths from the edges of boards, fed to the knife in a similar way, is not new. In some instances the knives used have formed a very obtuse angle in the middle, so as to cut first at the two ends, and this plan we think much preferable to the jointed knife which is at every instant altering its cutting angle. Still, should the machine before us be preferred, we think that enough of novelty might be pointed out upon which to found a valid claim.

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21. For a *Tobacco Press*; John W. Weems, West River, Anne Arundel county, Maryland, December 15.

There is not the slightest novelty in this press, although such a one may not have been used for pressing tobacco. The piston, or driver, placed horizontally, is a rack into which a pinion works, this pinion being on the shaft of a cog wheel, turned by a pinion on the shaft of a drum; or hand wheel. The hogshead into which the tobacco is to be pressed is rolled on to the frame, or ground sills of the press, one end resting against a head block, and the follower being brought up against the tobacco contained in it.

The claim is to "the before described press, for pressing tobacco and other substances."

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22. For a *Machine for Cleaning Buckwheat*; Daniel T. Laning, Bridgeton, Cumberland county, New Jersey, December 15.

A stationary hollow cylinder is to be made and fixed on a suitable frame, its periphery being in part formed of boards, and in part of woven wire. An axis passing through the centre of this cylinder carries four wings made of plank, which are caused to revolve by means of a whirl placed on the end of the shaft, thereby agitating the buckwheat which is put into the cylinder, and throwing it against the woven wire, through the meshes of which the foreign matter escapes. The claim is to "the said machine."

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23. For *Sharpening Razors, Surgical Instruments, &c.*; William Child, city of Baltimore, December 15.

Nothing can be more vague than the, so called, specification of this patent, which, we suppose, is taken for the application of some kind of hone, or slate, which the patentee has found in a quarry or bed, somewhere; even this, however, is mere conjecture, as will be seen by quoting his own words, which are, that "this discovery consists in applying adhesive or polishing slate for the purpose aforesaid, which slate or matter is composed principally of silica, of alumine, water, oxide of iron, a trace of lime, and a trace of magnesia, its specific gravity 2.6 to 2.8.

"This matter or slate may be used in any form most convenient, either as a hone, or being pulverized into a fine powder, may be placed on common razor straps, &c."

"What I claim as my invention is the application of slate or matter of the character above described, to the sharpening of the instruments and edge tools above described."

This new composition of matter was undoubtedly put together a few thousand, and possibly a few million of years, prior to the period when the serpent beguiled eve, and even prior to the ages in which the Saurian monsters were the lords of the land and of the ocean. "Whetstone, slate, or hone," we are told by Bakewell, "is a variety of talcy slate, containing particles of quartz; when these particles are extremely minute, and the slate has a uniform consistence and requisite degrees of hardness, it forms hones of the *best* quality." If the patentee has discovered any hones still *better*, he ought at least to have told us where he had found them, that after the expiration of his *exclusive right* to the sharpening of his razor upon a transition rock, we might enjoy the same privilege in the same degree.

24. For *Water and other Cisterns*; Alfred Palmer, Syracuse, Onondaga county, New York, December 15.

We are informed that this patent is taken for an improvement upon that of George Tibbet's, dated December 30, 1833, (see p. 25, vol. xiv.) In the present case we shall content ourselves, and probably our readers also, by giving no more than the claim.

"What I claim as my own invention in the mode of constructing cisterns, is the taking out the tubes or curbs, and leaving the cisterns of solid cement or other hard substance, the out and insides being partially smooth and free from the inconvenience of perishable materials, and of the cleaving off of the plastering." For remarks on a similar cistern, see p. 407, last volume, and also in other places too numerous to mention.

25. For an improvement in *Lamps*; patented October 6th, 1835. Patent surrendered to correct a clerical error, and re-issued December 16, Samuel Rust, city of New York.

The original specification was, it appears, considered by the patentee as defective, and the patent under it was issued by mistake, and contrary to his request. The form of the claim as contained in the corrected description is as follows:

"My improvement does not consist in a *stopple*, or in a *tube*, or in a *cap*, but in the application and combination of a *roller* or of *rollers*, with the said tubes, or sockets, *cap* and *stopple*, in or to the lamp as above set forth, or in any other way or manner that is essentially the same. Or inserting any *roller* or *rollers* into any *tube* or *socket* of any lamp whatever that is made to receive the wick with the said roller or rollers operating and regulating the wick of a lamp on this principle, and for which I request a patent."

We gave a brief description of the contrivance above alluded to at p. 326 of the last volume, to which we refer those who are desirous of obtaining an idea of its nature, which the above claim certainly does not convey.

26. For a *Door Lock*; John R. and Henry C. Campbell, Charleston, Middlesex county, Massachusetts, December 28.

This is a combination lock, in which certain letters, or figures, are used to regulate the parts upon which the opening of it is dependant. There is nothing new in the principle, and the arrangement is susceptible of indefinite

changes; the modes pointed out by the patentees, are the foundation of their claim to invention, and these we do not think it necessary to particularize.

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27. For a *Steam Gauge Tube for Steam Boilers*; Samuel Raub, Jr., Wilkes Barre, Luzerne county, Pennsylvania, December 28.

This contrivance is to be called a *life saving machine*, and is intended to prevent explosions in steam boilers; the aim and the end proposed are certainly worthy of all praise, but most unfortunately we do not understand the means, or mode of operation, although nothing can be more simple than the contrivance itself, as it consists merely of a tube which is to be secured to the top, and is to reach down thence to the bottom, or nearly to the bottom, of the boiler, which tube is to have openings on its sides, extending up to a point somewhat above the surface of the water. A second tube is to slide closely down within the former, and is to extend above it; when this dips into the water, no steam, we are told, can escape; but when it is raised the steam will pass through the openings of the first, into the second tube and be discharged freely into the atmosphere. "To ensure perfect safety the second tube should always be raised according to a gauge or scale to be ascertained for each boiler." "This is claimed as an improved mode of construction different from those heretofore in use." The next improvement, we suppose, will be to boil the water in an open kettle, from which the steam might reach the atmosphere without being put to the trouble of passing through a tube.

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28. For a *Thrashing machine*; Moses Davenport, Phillips, Somerset county, Maine, December 28.

The general mode of thrashing by a cylinder and concave, is employed in this machine, the concave being placed above the cylinder. The claims made are to a feeding roller with teeth, which takes the unthrashed grain from a feeding apron, and aids in conducting it to the cylinder, and to what is called a separator, which allows the grain to pass through to riddles and fans, whilst the straw is carried off. There is nothing in this machine that requires particular notice.

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29. For a *Machine for renovating and cleaning Feathers*; Edmund Wood, Owego, Tioga county, New York, December 28.

If feathers are not cleaned and renovated, it will not be from the scarcity of machines designed to effect those purposes, the difficulty will be to choose between them, on account of their great resemblance to each other. That before us, is provided with a box, or case, to receive the feathers, having in it revolving beaters to stir them up, and beneath it a steam boiler with a tube leading into it; and in the bottom of this box there are perforations to allow dust to escape. So far, this machine is so much like some others, as to appear to be actually of the same species. There are, however, certain improvements in the dressing of the feathers not before proposed; one to disinfect them, and another to supply them with animal oil. The first is to be accomplished by putting lime and vinegar into the boiler instead of water, and supplying the feathers with the vapour therefrom. This process is rather unchemical, and appears to be put into the description for effect. To supply the feathers with animal oil, should they be deficient in this article, the cloth which is to cover the box is to be imbued with goose grease, deer foot, or other preferred oil, and the feathers as they are agita-

ted and strike against the cloth, are to absorb the requisite dose of this material, to which odoriferous articles may be added. The claims are to the apparatus, and also to the disinfecting and the oiling processes.

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30. For a *Brick Machine*; Benjamin Hamblett, Portland, Cumberland county, Maine, December 28.

The clay is to be mixed in a box by revolving arms or knives, in the manner well known, and from the lower end of this it is to pass out through an opening to be moulded and struck. The apparatus is described at great length, and there are several distinct claims; the machine so nearly resembles some of its predecessors that any attempt at description and comparison, would demand much room, and consume more time than we have to spare. The claims alone would not furnish a correct idea of the things claimed.

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31. For an *Amalgamating Mill to separate Gold from the Ores*; Joseph Curtis, city of New York, December 28.

In this mill or amalgamating apparatus, the aim is to amalgamate the gold by forcing the ore, mixed with water, through mercury, by hydrostatic pressure. The apparatus for this purpose is clearly described and represented in the specifications and drawings. The mercury is to be contained in a cast-iron pot, at the lower part of the apparatus, and an iron tube reaching nearly to the bottom of the pot, rises vertically above it, and is lengthened out by a copper, or other, tube, so as to be about five feet in height. Through this tube, the ore, finely pulverized and mixed with water, is to be fed to the amalgamating pot, into which it passes and rises up through the mercury, by the superincumbent pressure. As it rises it has to pass over and under a number of iron shelves or partitions, which cause it to pass very circuitously before it arrives at the spout through which the earthy matter and water are to escape. To ensure the more perfect distribution of the ore, the feeding tube, with the shelves attached to it below the surface of the mercury, are made to revolve, there being a gudgeon working in a step at the lower end of the tube, and numerous small perforations to allow the ore and water to pass through.

The claim is to "the application of hydrostatic pressure to the passing of ore through a stratum of quicksilver by means of the mechanical combinations set forth in the above described mill, or by any other combination that may be preferred."

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32. For an *Amalgamating Mill to separate Gold from the Ore*; Joseph Curtis, city of New York, December 28.

The apparatus here used is the same with that described under the last patent, but with the addition of the application of heat to the iron pot containing the mercury. The claim is "to the application of heat to the ore in passing through the stratum of quicksilver, by making the fire glide around or beneath the vessel in which the process is carried forward, in the manner aforesaid or in any other manner preferred."

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33. For an *Amalgamating Mill to separate Gold from the Ore*; Joseph Curtis, city of New York, December 28.

There is but very little verbal difference between this and the last specification, both of them differing from the first in the application of heat to the amalgamating pot, and in their having an iron tube leading from the

bottom of the pot, through the fire place; which tube is to become heated to such a degree as will evaporate the mercury, and cause the gold to be deposited within the tube, a process which it is supposed, will be continued by the passing down of fresh portions of the amalgum, and the condensation of the mercurial vapour on its return to the amalgamating vessel.

The claim in this last specification is to "the application of hydrostatic pressure to the passing of ore through a stratum of quicksilver in combination with the application of heat to the ore in passing through the stratum of quicksilver in manner aforesaid, or in any other manner preferred."

We suppose that the patentee could give a good reason for taking three patents for the foregoing process, instead of including the whole in one, although we are unable to perceive it. The last two, in fact, appear to us to be for precisely the same thing.

35. For a *Combined Cam Apparatus or Press*; Alonzo S. Greenville, Cambridgeport, Middlesex county, Massachusetts, December 30.

This apparatus, as its name indicates acts by a combination of cams, and it is intended to be used wherever heavy weights are to be raised or moved short distances, and also in such presses in which the toggle joint, or similar contrivances, are usually employed. Cams of several different sizes are placed upon the same shaft and operate like eccentrics, upon friction wheels which are likewise of different sizes; the whole to be so graduated as to adapt them to the particular purpose to which they are to be applied; describing its application to a printing press, the patentee says, "In the commencing operation of the press, the larger cam is in contact with the smaller wheel, and the descent of the platten is then, of course, the most rapid; the second and third cams then come successively into contact with their corresponding wheels, the power being thereby progressively increased in any desired proportion."

"What I claim as my invention, and wish to secure by letters patent, is the employment of the combined cam for raising weights and overcoming resistances; operating upon the principle herein set forth. I do not intend, in the construction of the same, to confine or limit myself to the precise mode by which I have exemplified my invention, but to vary the same in any way that I may find convenient, and which is in accordance with the same principle or mode of action. I also claim the particular manner of raising a platten or follower herein described."

36. For a *Machine for Ironing*; Samuel Swett, Jr. Redfield, Kennebec county, Maine, December 30.

A cylinder, covered with flannel, or some other like substance, is to revolve at one end of the table, and upon this cylinder rests an iron plate, concave beneath, and flat at top, to receive iron heaters, the clothes to be ironed are carried, by means of a "feeder," between the roller and the heated iron which rests upon it, and when passed through the process is complete.

We do not think it necessary to lengthen out our description, as we believe that brevity will be found to correspond best with the history of this invention.

36. For a *Thrashing Machine*; Amos Hanson, Windham, Cumberland county, Maine, December 30.

This is a machine of the most common construction, and the claim made

is to "the pulleys, bands, and wooden wheels, and the manner of operating the same thereby," a claim about as good as any that could be made where there is nothing upon which to found one.

37. For a *Mowing and Reaping Machine*; Alexander M. Wilson, Rhinebeck, Dutchess county, New York, December 30.

This, like some other mowing machines, is to be driven forward by a horse, and it has on its front a horizontal revolving wheel which carries the cutters by which the mowing, &c. is to be effected. This wheel is caused to rise with the rise of the ground, by the action of small wheels or rollers, and is itself driven by means of a band around a drum on the axle of the large wheels. There are several appendages which it would be in vain to describe without the drawing. The claim is to the fly wheel with its knives or cutters, substantially as described, together with the general arrangement of the apparatus. Similar cutter wheels have been employed, and we do not see any thing in the general construction of this machine likely to insure its operating better than other mowing machines previously patented in this country and in Europe.

38. For an improvement in the *Escapement for Time Keepers*; James Fulton, Shelby county, Kentucky, December 30.

There are twenty-six figures referred to in the drawings of this improvement. The claims made, are to "the arrangement of two separate locking pallets in such a manner that they will receive the action of the teeth or pins of the scape wheel, by having springs so connected with the pallets, or with arms projecting from their axes, that by the movement of the wings or levers to which the other ends of the springs are attached, or by both, each of the pallets is alternately, in one part of the vibration, held by the pressure of the spring, in a position to come in contact with the teeth of the scape wheel, and in the other part is caused, as soon as relieved from the teeth by the other pallet, to move out of their way."

#### SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a patent for an improved mode of raising sunken vessels, &c. Granted to WILLIAM ATKINSON and EBENEZER HALE, city of New York, December 2d, 1835.*

To all whom it may concern, be it known, that we, William Atkinson and Ebenezer Hale of the city, county and state of New York, have invented a new and improved mode of raising sunken vessels, and other articles, from the bottom of rivers, seas, bays, and other waters, and which may also be employed to prevent the sinking of such vessels, or other articles, and that the following is a full and correct description thereof.

We prepare bags which are impervious to air and water, and to them we attach hose, or tubes, properly prepared, and of such length as may be necessary for the intended purpose. The most effectual way of preparing such bags and hose, is by coating canvass, or other cloth of sufficient strength, with caoutchouc, or India rubber, in a manner now well known. The form of the bags may be varied, but the best is that of a globe, as when they are distended by filling them with air, more will be contained under the same bulk than in any other form.

The bags should be properly strengthened by bands of canvass or cordage, and be sunk in the water, and firmly attached to the vessel, or other article to be raised, which may be done by means of a diving bell, or in any other way which the particular circumstances of the case may render convenient.

The hose or tubes, leading to each bag, must be of sufficient length to extend from it to the apparatus by which the bag is to be inflated, which may be on board of a moored vessel, or otherwise. The distending apparatus will consist of a common condensing or force pump, by which the air may be forced through the hose, or tube, so as to distend the bag.

It may be found convenient, and we sometimes intend, to fill the bags before sinking them, proper tackle and blocks being attached to, or passed under the vessel or other article to be raised. The inflating of the bags may in this case be rapidly effected by the use of a large, common bellows. We intend also, to use such bags, so inflated, within the hold, cabin, or other parts of vessels, which, when not wanted, will occupy but little space, and when required, may be easily inflated by a pair of bellows adapted to that purpose. In all cases, suitable air-tight valves or cocks, should be employed, and such other appendages as may be found useful for coupling the inflating apparatus, or otherwise, when securing the air within the bag.

It is not necessary for us to prescribe the size, or number of the bags to be employed: nor indeed would it be possible to do so, without assuming a particular case, but it is manifestly a thing of easy calculation, and one which must be made in every individual instance.

What we claim as our invention, and wish to secure by letters patent, is "the employment of bags rendered impervious to air and water, and furnished with hose or tubes, cock or valves, through which they can be filled with air, after being sunk and properly secured to a vessel, or any other article intended to be raised from the bottom to the surface of any water; or when first distended and afterwards sunk, as herein described. We also claim their use or employment for preventing the sinking of vessels or other articles, as set forth by us."

WILLIAM ATKINSON,  
EBENEZER HALE.

*Specification of a patent for an improvement in the Wheels of Rail Road Cars. Granted to ARUNDIUS TIERS, Kensington, Philadelphia county, Pennsylvania, December 2d, 1835.*

To all to whom these presents shall come: Be it known, that I, Arundius Tiers, of the district of Kensington, in the county of Philadelphia, and state of Pennsylvania, have invented a new and useful improvement in the construction of wheels for rail road cars, and that the following is a full and exact description of the construction of said wheel as invented and improved by me. The wheel is to be made of cast iron, with a wrought iron band shrunk upon it, to form the tread of the wheel. The form and shape of the respective parts of the wheels which I most prefer, is exhibited in the drawing.

In the construction of that part of the wheel which is made of cast iron, the flanch A, B, in the accompanying section, is chilled and hardened in the mould as it is cast, in the ordinary way of chill-hardening cast iron. A small rim or flanch C, D, is formed and cast on the inner side, or face

of the wheel; this rim is intended and used to confine the wrought iron band which is afterwards to be put around the wheel. The wrought iron band E, F, is first welded together in the form of a hoop, and then heated until it has expanded sufficiently to pass over the small rim, or flanch, above referred to, when it is allowed to become cool, and to contract upon the wheel as exhibited in the drawing. This wheel possesses all the advantages of a chilled, cast iron flanch, with a wrought iron band or tread, and is therefore deemed to be decidedly preferable to the cast iron wheels with wrought iron flanches, inasmuch as the wrought iron flanches soon wear out, especially on roads that have frequent curves in them. This wheel is also exempt from one of the greatest objections to the common, chilled cast iron wheels, in being free from slits in the hub, the small quantity of metal which requires to be chilled in this wheel allows the wheel to be cast solid in the hub, and renders the precautionary operation of slitting the hub entirely unnecessary. The shape of the band is that of a flat, or oblong square, and hence it may be formed by the ordinary rolls; and consequently, when worn out may be replaced at a small expense.



What I claim as new and as my own invention or discovery, in the above described wheel, and for which I ask an exclusive privilege, is "the manner of constructing wheels with chilled flanches and wrought iron bands, as above described."

ARUNDIUS TIERS.

### Practical and Theoretical Mechanics and Chemistry.

#### *Davy's Safety Lamps.*

Evidence of Jonathan Pereira, Esq., F. L. S., Chemical Lecturer at the London Hospital, &c.

What is your opinion of Sir Humphrey Davy's lamp, as a security against the effects of carburetted hydrogen gas?—I do not think it is a security, because the lamp will allow the passage of the flame through it.

Will it allow the passage of the flame when suspended in the carburetted hydrogen gas, without motion? I have never seen the flame pass through the wire gauze when the lamp was at rest, and the gas not in motion. Under such circumstances the lamp may be safe, at least I have never seen it explode.

Have you seen it explode under other circumstances? Repeatedly, when the lamp, or the gas, has been in motion. I was accustomed for years to show the Davy-lamp in my lectures, and by certain experiments to demonstrate, as I then thought they did, the security of the lamp. The experiments are those usually shown in the lecture room. I am now convinced they are fallacious. There are three methods mentioned by Sir Humphrey Davy, of proving the safety of the lamp: the first method (mentioned at p. 14, 15, of his work, on the "Safety-lamp for coal-miners,") is to plunge the lamp into an explosive mixture contained in a large vessel; the second method (mentioned at p. 16 of Davy's before-mentioned work,) is to hang the lamp in a large glass receiver, through which a current of explosive gas is made to pass; the third method adopted by Sir Humphrey Davy, was tried on a "blower" in a coal

mine. He held the lamp in this blower, and though the wire-gauze soon became red hot, the flame did not pass until the gauze had reached a welding heat, and began to burn. (This is mentioned at p. 138 of his work.) Of course lecturers in London have no means of exposing it to a blower, and therefore they have usually employed, as class-room experiments, the first two mentioned methods of trying the lamp. I have never found the lamp explode by either of those methods; but, as I have already remarked they are fallacious experiments.

You think the lamp, if exposed to a current of explosive gas, decidedly unsafe? Yes, certainly. I will not say it is absolutely safe when the lamp is not moved, and where there is no current; but under such circumstances, I have never seen it explode. I may perhaps mention in what way I became convinced of the insecurity of it. Mr. Roberts has been employed by me for some years as a manufacturer, &c. of lamps; and on several occasions he told me that he was certain the Davy-lamp was not "a safety-lamp." Although I was aware that Roberts had particularly directed his attention to this subject, and from having been a working miner for many years must have been practically well acquainted with the lamp, yet as he was not accustomed to the niceties requisite in conducting chemical experiments, as I and many others had tried the lamp, and as far as I then knew, it had always been found a security against the passage of flame, I confess I thought Roberts was labouring under an error. At his urgent and repeated request, I ultimately consented to attend at Upton and Roberts' manufactory, to see him prove, if he could, the insecurity of the lamp, though fully persuaded that I should be able to find some fallacy in his experiments. In a few minutes he showed me that flame might be made to pass through a Davy-lamp; but thinking that the lamp he employed might not be perfect, I sent for one which I had repeatedly tried, and which I knew to be a perfect instrument. The flame passed through this also. Subsequently I tried the Davy-lamps of some friends, and in every case they allowed the passage of the flame. I then undertook a series of experiments, the result of which is a firm conviction of the insecurity of the Davy-lamp when in motion, or when placed in a current of explosive gas. I think we may easily comprehend why the flame does not pass when both the gas and the lamp are at rest: it depends on two circumstances, namely, the less heat developed in consequence of less gas burning; and secondly, the carbonic acid formed not being got rid of, checks the passage of the flame through the wire gauze. I think, however, that the latter is the most efficient cause, since the gauze will allow the passage of the flame when it (that is the gauze) is not hot enough to be luminous, so that a great heat is not essential. Now when a Davy-lamp is plunged into a jar of explosive mixture, a quantity of carbonic acid is immediately formed, and this mixing with the unconsumed portion of the explosive mixture, diminishes its combustibility, and therefore its explosive powers. If, on the contrary, you expose the lamp to a current of an explosive mixture, the carbonic acid which is developed is immediately got rid of, (as well as the nitrogen of the portion of atmospheric air employed in carrying on the combustion,) and then the flame passes. A gentle motion of the lamp, combined with the current of the gas, very much promotes the passage of the flame. If, for example, a lamp be held before a jet of gas until it becomes hot (a red heat is not essential), and then gently moved, the flame will pass, and the experiment may be repeated successively a number of times in a minute. Sir Humphrey Davy was well acquainted with this fact, that carbonic acid diminishes the explosive power

of gaseous mixtures. At p. 10 of his work, he says:—"On mixing one part of carbonic acid, or fixed air, with seven parts of an explosive mixture of fire-damp, or one part of azote with six parts, their powers of exploding were destroyed." At p. 32 of his book, Sir Humphrey Davy states that "the consideration of these various facts led me to adopt a form of lamp in which the flame, by being supplied with only a limited quantity of air, should produce such a quantity of azote and carbonic acid as to prevent the explosion of the fire damp, and which, by the nature of its apertures for giving admittance and exit to the air, should be rendered incapable of communicating any explosion to the external air." It is evident, therefore, he endeavored to form a lamp which should be safe from the combined influence of the carbonic acid gas, of the azote or nitrogen gas, and of the wire gauze.

State to the Committee in what way you think the lamp of Messrs. Upton and Roberts is an improvement on that of Sir Humphrey Davy?—There are several points of view under which we may regard it as an improvement. In the first place, it is quite evident that the wire-gauze of the common Davy-lamp partially obstructs or impedes the passage of flame through it; and, therefore, if you employ two layers of wire-gauze, the obstruction is greater than that produced by one. Now in practice two layers of gaze are objectionable; first, because such lamps would give very little light, and secondly, because the gauze would soon become clogged up. But even if these objections could be overcome, there exists a still more weighty one, namely, that the lamp, even with a double layer of wire-gauze, is not secure. I have repeatedly passed flame through lamps of this kind; the experiment occupies a little longer time, because the flame passes less readily through two than one; but it does pass, and therefore such a lamp is insecure. Now in Upton and Robert's lamp only one layer of wire-gauze is employed, and therefore there is little impediment to the light. To prevent the effects of lateral currents, they use a cylinder of glass placed external to the gauze. This is one improvement over the common Davy-lamp; it must be admitted, however, that Davy, at p. 136 of his work, proposed, screens to increase the security of his lamp; but neither the screens of Davy, nor the cylinder of glass employed by Upton and Roberts, would of itself be sufficient to make the lamp secure. Hence, therefore, we come to the next part of the improvement made by Upton and Roberts, and which consists in the manner they admit the external air, or the explosive mixture, to the interior of the lamp. Around the lower part of the lamp is a number of apertures, through which the air passes into a chamber, the ceiling of which consists of layers of wire-gauze. To increase the security of the lamp, any number of these layers may be employed; they are easily taken out and cleaned, and they offer no impediment to the light: whereas in Davy's lamp, any increase in the number of wire-gauzes diminishes the light. This then constitutes a most important improvement. I now pass on to another improvement in this lamp, and which in fact constitutes its superiority to all other safety-lamps that I have seen: when the air or gas has passed through the wire-gauzes, it does not pass immediately into the body of the lamp, but into a second chamber, bounded above by a conical piece of brass, having a central aperture about the size of a sixpence, in the middle of which is the wick; so that all the air passing into the lamp, is brought in contact with the wick, and thus increases the quantity of light evolved; and as the aperture is much smaller than the cavity of the wire-gauze cylinder, the latter cannot fill with flame when introduced into an explosive mixture, so that the flame can never touch the wire-gauze cylinder; and, indeed, be-

tween the flame and the cylinder there is no oxygen to support combustion, as may be shown by its extinguishing a taper; we have, therefore, the very condition Sir Humphrey Davy wanted, since no taper will burn in the space between the flame and the wire-gauze; so that you observe we have three impediments to the lateral passage of the flame, a layer of carbonic acid, a wire-gauze cylinder, and a cylinder of glass. The safety of the bottom consists in any number of wire-gauzes the maker may choose to employ, and therefore if the lamp is not safe it is his fault.

Then how is the top of the lamp secured? It is made safe by layers of wire-gauze, and also by having a contracted aperture to the glass, by which the draught is increased; and all the carbonic acid gas that is formed below, by the combustion of the fire-damp, or of the oil of the lamp, as well as the nitrogen of the atmospheric air, contribute to prevent the combustion of a body in this situation, for if you put a lighted taper here, it is extinguished immediately. Thus then this lamp is made safe at the sides, at the bottom, and at the top, by different methods. If the glass should break, the lamp is then a common Davy-lamp.

Have you made experiments on that lamp in the explosive mixture?—I have submitted this lamp to every experiment I have submitted the Davy-lamp to, and I could never get this to explode; indeed, I have submitted this lamp to a test (oxy-hydrogen gas) which it is not likely to be put to in actual practice.

This lamp then is safe in a draught or current of explosive gas?—Yes, it is perfectly safe in any current of carburetted hydrogen gas, or of this gas and oxygen, or of this gas and air. I have repeatedly tried it, and the flame will not pass. When the explosive mixture was blown in gently, the flame increased in size; if passed in with violence, the flame was extinguished, but no passage of it will take place through the gauze.

Lond. Mech. Mag.

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*On Impact and Collision.* By EATON HODGKINSON.—Mr. Hodgkinson reported to the Section the results of certain experiments made by him on impact and collision, in continuation of those communicated to the Association in the year 1834, on the collision of imperfectly elastic bodies. The results were,

First, That cast-iron beams being impinged upon by certain heavy masses or balls of metal of different kinds, were deflected through the same distance, whatever were the metals used, provided that the weights of the masses were equal.

Secondly, That the impinging masses rebounded after the stroke through the same distances, whatever was the metal of which they were composed, provided that the weights were the same.

Thirdly, That the effect of the masses of different metals impinging upon an iron beam were entirely independent of their elasticities, and were the same as they would give if the impinging masses were inelastic.

Mr. Hodgkinson also gave the result of some interesting experiments on the fracture of wires under different states of tension, from which it appeared that the wire best resisted fracture and impact when it was under the tension of a weight which, being added to that impinging upon it equalled one third of the force that was necessary to break it.

*Marine Steam Engine. Extracts from the evidence given by Joshua Field, Esq., of the house of Messrs. Maudslays and Field, before the Select Committee on Steam Navigation to India.*

You have had much experience in the manufacture of engines for steam vessels, have you not? Yes, I have.

What do you consider the proper measurement and power of a steamer for a long sea-voyage? The relative proportion of power and tonnage fluctuates between two tons per horse power and four tons per horse power, depending upon the purposes for which the vessel is intended, as well as the length of the voyage.

What do you say as to the measurement? By measurement, I understand tonnage. I have prepared a table which shows at one view the probable speed to be obtained by the application of engines of four different powers in vessels of the same tonnage, also the length of time for which they would be able to carry coal with each power on board. This table, if the committee desire it, I will put in.

AN APPROXIMATE TABLE,

*Showing, at one view, the Tonnage of Steam Vessels with the power usually applied to such Vessels; the Number of Days of Twenty-four Hours' Coals they will carry, and the probable Speed they will go with smaller Powers and greater Quantity of Coal.*

Tonnage of Vessel.	Power of Engines.	DaysCoal	Power of Engines.	DaysCoal	Power of Engines.	DaysCoal	Power of Engines.	DaysCoal
252	100	5	80	6 $\frac{1}{4}$	60	8 $\frac{1}{4}$	40	12
290	100	6	80	7 $\frac{1}{2}$	60	10	40	15
332	120	7	100	8 $\frac{1}{4}$	80	10 $\frac{1}{2}$	60	14
375	120	8	100	9 $\frac{1}{2}$	80	12	60	16
425	140	9	120	10 $\frac{1}{2}$	100	12 $\frac{1}{2}$	80	15 $\frac{3}{4}$
480	140	10	120	11 $\frac{1}{2}$	100	14	80	16 $\frac{1}{2}$
534	160	11	140	12 $\frac{1}{2}$	120	14 $\frac{1}{2}$	100	17 $\frac{1}{2}$
597	160	12	140	13 $\frac{1}{2}$	120	16	100	19
665	200	13	160	16	140	18 $\frac{1}{2}$	120	22 $\frac{1}{2}$
736	200	14	160	18 $\frac{1}{2}$	140	20	120	23 $\frac{1}{2}$
810	220	15	200	16 $\frac{1}{2}$	160	20 $\frac{1}{2}$	140	24
892	220	16	200	17 $\frac{1}{2}$	160	22	140	26
980	240	17	220	18 $\frac{1}{2}$	200	20 $\frac{1}{2}$	160	25 $\frac{1}{2}$
1,073	240	18	220	19 $\frac{1}{2}$	200	21 $\frac{1}{2}$	160	27
10 miles per hour.			9 miles per hour.		8 miles per hour.		7 miles per hour.	

Will you explain to the Committee the object of this calculation; is it a comparison of tonnage with the consumption of coals and days, and the rates of going? It is to show about how many days' fuel steam vessels will carry with larger and with smaller engines on board, as well as the average speed to be expected from each. Such a table can only be an approximation.

Will you first state what you consider the proper measurement and power of a steamer to go a long sea-voyage? I should recommend a vessel of from 700 to 800 tons, having an engine of 180 or 200 horse-power.

How long would such a vessel run, and at what rate would she go? She would carry coal for 14 or 15 days, and have a speed, in still water, of 9

or 10 miles per hour, and would realise in all weathers at sea, an average of 8 miles while under weigh.

What is the greatest proportion in tonnage and power for a steamer going a long voyage? The greatest proportion of tonnage for vessels going long voyages may be stated at 4 tons per horse-power. For short sea-voyages 3 tons per horse-power; and for river vessels, as Margate or Gravesend, 2 tons per horse-power.

What results does the power give to a vessel of the same tonnage with different powers as to the rate of going? Great power in small vessels gives great speed, but they carry a small quantity of coal and are soon exhausted, while larger vessels being able to carry a greater quantity of coals, work longer and perform greater distances.

Then you draw this inference—the longer the voyage the less the speed? The smaller the power the greater capacity there is left for coal, and, therefore, the greater number of days' coal it would carry.

And the less speed? And less speed, having less power.

And the smaller proportion of power would, of course, consume less fuel in an equal time? Exactly so.

Would not the greatest proportion of power consume the least fuel in equal distances? Against winds or tides it is so, but in calms and fair winds it is not.

What is the greatest distance you suppose a sea-going steamer to run without changing? The same steamer should not go more than 2,000 or 3,000 miles without a relay, or time to put the machinery in order.

Does that also include without taking in coals? A voyage of 2,000 or 3,000 miles may be performed in one stage, but it would be desirable on every account to divide it and take less coal.

What is the greatest distance she would go without coming to a station to take in fresh coals? The distance is limited only by the quantity of coal she can carry.

What is the greatest distance you think a steamer could go without taking in fresh coals? The greatest distance I have known a steamer to perform was the *Enterprize*, on her voyage to the Cape, in which she carried 37 days' coal.

With continued steaming, do you mean? Yes; she steamed 34 days, and had three days coal left.

Do you mean steaming day and night? Yes.

Besides the coal, is it not necessary to give the engines rest? It is; and the more frequently they can be stopped to clean and adjust, the better they will perform.

Then your observation must be supposed to apply to both? Yes.

Lond. Mech. Mag.

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*On the immersion of Copper for Bolts and Ship Sheathing in Muriatic Acid, as a test of its Durability.* By DAVID MUSHET, ESQ.—The durability of copper for bolts and ship-sheathing being an object of great national importance, and as there is no better test of its resistance to waste, than immersion in muriatic acid, the following experiments, made thirteen years ago, will, it is hoped, be found not uninteresting.

Small quantities, presenting nearly equal surfaces of each of the kinds of copper described in my last communication, namely, pure shotted copper

of the quality from which brass is made, and shots obtained from unrefined copper, were separately immersed in equal weights of muriatic acid. The immersion having been continued for 48 hours, the acid was poured off, and the copper washed repeatedly, and thoroughly dried. The pure copper had lost at the rate of  $5\frac{1}{2}$  grains in 100. But the unrefined copper, on being weighed, seemed to have gained half a grain; so that either a mistake must have been made in the weighing, or else a portion of unexpelled moisture had remained in the porous flakes of the copper.

Six ounces of unrefined copper were mixed with three times their bulk of charcoal, and exposed for six hours to a high heat of cementation much beyond what in the absence of the cementation would have sufficed to melt the copper. The flakes of copper were found surrounded by the charcoal, welded together without fusion, and soft and extremely flexible. Six ounces of the pure copper shots were treated in a similar manner, but the result was so far different that no adhesion of the masses had taken place, and the only perceptible change was a slight cracking or bursting upon the surface of the spheroids, which may be considered as a prelude to fusion. Both results were melted down with charcoal and run into iron moulds. The unrefined copper, when cold, was the strongest and softest; a bar of it, about  $\frac{3}{8}$ ths of an inch thick, cut easily across with a knife, and in colour and general appearance it very nearly resembled Swedish copper. Another piece was flattened out thin when cold for the purpose of immersion in the muriatic acid. The pure copper was melted in rather a higher degree of heat, and although not teemed until it had assumed a creamy surface, and the crucible had fallen to a low red temperature, it was crystalized throughout the whole fracture. The surface and the fracture of this copper were of a red colour; the body weak, and tearing with facility into pieces. Fragments for immersion were cut off and flattened.

The following specimens were then placed separately in muriatic acid.

No. 1, Pure copper, cut off with a chisel,	53 grains
2, Ditto, flattened,	30 —
3, Unrefined copper, cut off with a knife	$39\frac{1}{2}$ —
4, Ditto, flattened, in which stuck a minute } portion of the knife,	45 —

On the morning of the third day the following remarks were made upon their respective solutions:

No. 1, Light green colour, very transparent when dashed against the sides of the glass. No. 2, equally transparent, but the green was brownish and not so decidedly cupreous. After continuing the immersion for 48 hours longer, the acid was poured off and the specimens were well washed and dried.

No. 1, That weighed 53 grains, now weighed	$39\frac{1}{2}$ grains.
Loss $13\frac{1}{2}$ grains, equal to 25.4 per cent.	
No. 2, That weighed 30 grains, now weighed	$11\frac{1}{2}$ —
Loss $18\frac{1}{2}$ grains. Equal to 61.2 per cent.	
No. 3, Unrefined copper flattened, $39\frac{1}{2}$ grains, now } weighed,	19 grains
Loss $20\frac{1}{2}$ grains. Equal to 50 per cent.	
No. 4, Unrefined copper bar, 42 grains, now weighed,	$38\frac{1}{2}$ —
Loss $3\frac{1}{2}$ grains. Equal to 8.33 per cent.	

It would appear from this experiment that the unrefined copper resists

waste in the muriatic acid, in the same way, and to nearly the same extent, as in the cementation with lime mentioned in my last previous paper.

In corroboration of this fact, we may take the following abstract of another series of experiments, wherein the specimens were weighed three times, at intervals of 48 hours between each weighing.

Unrefined copper, 1st immersion, lost,	.	.	.	15	per cent.
Ditto, 2nd ditto	.	.	.	$8\frac{5}{10}$	—
Ditto, 3rd ditto	.	.	.	6	—
				<hr/>	
				29 $\frac{8}{10}$	
				<hr/>	
Pure copper, 1st immersion, lost	.	.	.	25.4	per cent.
Ditto, 2nd ditto	.	.	.	9.7	—
Ditto, 3rd ditto	.	.	.	11.1	—
				<hr/>	
				46.2	

In favour of the unrefined copper, principally containing tin,—16.9 per cent. Two pieces of copper, the one pure, the other unrefined, were immersed, under similar circumstances, for seven days. The unrefined copper lost 17 per cent., and the pure copper 45 per cent. To ascertain whether the greater indestructibility was owing to the tin which remained in the unrefined copper, I formed a bar of alloy as follows:

Pure copper	.	.	.	2880	grains
Block tin	.	.	.	84	—

a proportion of tin about equal to 3 per cent. A piece from this bar weighing about 183 grains was exposed for seven days in muriatic acid, at the end of which time it was found to have lost 30 grains, or  $16\frac{4}{10}$  per cent. The unrefined copper, above mentioned, lost in the same time and under similar circumstances, 17 per cent., which is a striking correspondence. The same piece of tin alloy, at the end of five weeks, was found to have lost in all 76 grains, or  $38\frac{1}{2}$  per cent. Pure copper by the foregoing results lost in seven days' immersion 46.2 and 45 per cent.

In the first instance I was inclined to attribute the indestructibility of the unrefined copper in the acid, partly to the effects of the charcoal in the cementation, seeing that the effect produced by that operation was much greater upon unrefined than upon pure copper. Whatever advantages may belong to the proper use of charcoal in the reduction and cementation of copper (and I consider them not unimportant), the addition of a small portion of tin will be sufficient to account for the superior resistance to waste which this alloy presents in the muriatic acid, over that of the common refined copper of this country. This incapacity to rapid oxidation which is presented by the alloy of tin with copper, suggests many useful hints to the artists and the manufacturers, of which advantage has already been taken in forming ship-sheathing and other articles.

Lond. and Edin. Phil. Mag.

## Progress of Physical Science.

*Experimental researches in Electricity. Tenth Series. By* MICHAEL FARADAY, D. C. L. F. R. S., &c. &c. [From *Phil. Trans.* 1835, Part. II.]\*

The subjects embraced are, on an improved form of the Voltaic Battery,

\* Received by the Franklin Institute, through the kindness of the author.

and some practical results respecting the construction and use of the battery.

Mr. Faraday has previously shown that the chemical forces in the battery are two fold, one local and producing no useful effect, the other transferred and constituting the electrical current in the instrument. By ascertaining the quantity of zinc dissolved, compared with the decomposition produced, in a volta-electrometer, the ratio of the two effects just referred to, may be determined.

In a battery of zinc plates, enclosed entirely by platinum ones, which do not touch metallically, and excited by dilute sulphuric acid, there would be no local action without transfer.

If the surrounding metal be copper, and the exciting fluid dilute nitro-sulphuric acid, a very slight discharge takes place between the adjacent coppers, especially when the circuit is completed. The theory just stated induced the construction of a battery in which a thickness of paper was used to prevent metallic contact, and thus Professor Faraday was led to the re-invention of Doct. Hare's galvanic deflagrator. To the merits of this apparatus, and of its mechanical arrangements, Prof. Faraday does full justice, as full as if it had first originated with himself, while he refers the entire credit to its author Prof. Hare.

A deflagrator of forty pairs of three inch square plates, was compared with a battery of forty pairs of four inch plates of the ordinary form with double copper plates, insulated, and proved to be its equal in igniting platinum wire, the discharge between charcoal points, the shock, &c. The power of the deflagrator diminished most rapidly, because but one seventh of the quantity of acid liquid was required to excite it, the solutions in its trough and in the cells of the other battery being of the same strength.

To compare the two batteries, the amount of zinc dissolved for each equivalent of water decomposed in the volta-electrometer, was ascertained. Three acids were tried, sulphuric, nitric and muriatic. One cubic inch of the first dissolved 486 grs. of zinc, of the second 150 grs. and of the third 108 grains.

A mixture of 200 parts, by bulk, of water,  $4\frac{1}{2}$  of sulphuric acid, and 4 of nitric acid, was applied to the deflagrator before referred to, and to four troughs having plates of the size and construction before stated. One equivalent of water in the volta-electrometer, was decomposed for each 2 to  $2\frac{1}{2}$  equivalents of zinc dissolved from each plate of the deflagrator, while 3.54 equivalents were required from each plate of the common battery, for the same effect.

Twenty pairs of four inch plates in a deflagrator and twenty of the same size in a common battery, gave respectively 3.7 and 5.5 equivalents of zinc from each plate for the same effect. And with ten pairs, 6.76 and 15.5 equivalents, respectively, for the deflagrator and common trough.

Prof. Faraday remarks :—

"1131. No doubt, therefore, can remain of the equality or even the great superiority of this form of voltaic battery, over the best previously in use, namely, that with double coppers, in which the cells are insulated. The insulation of the coppers may therefore be dispensed with; and it is that circumstance which principally admits of such other alterations in the construction of the trough as give it its practical advantages.

"1132. The advantages of this form of trough are very numerous and great. 1. It is exceedingly compact, for 100 pairs of plates need not occupy a trough of more than three feet in length. 2. By Dr. Hare's plan of making the trough turn upon copper pivots which rest upon copper bearings, the latter afforded *fixed* terminations, and these

I have found it very convenient to connect with two cups of mercury, fastened in the front of the stand of the instrument. These fixed terminations give the great advantage of arranging an apparatus to be used in connexion with the battery *before* the latter is put into action. 3. The trough is put into readiness for use in an instant, a single jug of dilute acid being sufficient for the charge of 100 pairs of four inch plates. 4. On making the trough pass through a quarter of a revolution, it becomes active, and the great advantage is obtained of procuring for the experiment the effect of the *first contact* of the zinc and acid, which is twice or sometimes even thrice that which the battery can produce a minute or two after. 5. When the experiment is completed, the acid can be at once poured from between the plates, so that the battery is never left to waste during an unconnected state of its extremities; the acid is not unnecessarily exhausted; the zinc is not uselessly consumed; and, besides avoiding these evils, the charge is mixed and rendered uniform, which produces a great and good result, and, upon proceeding to a second experiment, the important effect of *first contact* is again obtained. 6. The saving of zinc is very great. It is not merely that whilst in action, the zinc performs more voltaic duty, but *all* the destruction which takes place with the ordinary forms of battery between the experiments is prevented. This saving is of such extent, that I estimate the zinc in the new form of battery to be thrice as effective as that in the ordinary form. 7. The importance of this saving of metal is not merely that the value of the zinc is saved, but that the battery is much lighter and more manageable; and also that the surfaces of the zinc and copper plates may be brought much nearer to each other when the battery is constructed, and remain so until it is worn out: the latter is a very important advantage. 8. Again, as in consequence of the saving, thinner plates will perform the duty of thick ones, rolled zinc may be used; and I have found rolled zinc superior to cast zinc in action; a superiority which I incline to attribute to its greater purity. 9. Another advantage is obtained in the economy of the acid used, which is proportionate to the diminution of the zinc dissolved. 10. The acid also is more easily exhausted, and is in such small quantity that there is never any occasion to return an old charge into use. Such old acid, while out of use, often dissolves portions of copper from the black flocculi usually mingled with it, which are derived from the zinc; now any portion of copper in solution in the charge does great harm, because, by the *local* action of the acid and zinc, it tends to precipitate upon the latter, and diminish its voltaic efficacy. 11. By using a due mixture of nitric and sulphuric acid for the charge, no gas is evolved from the troughs; so that a battery of several hundred pairs of plates may, without inconvenience, be close to the experimenter. 12. If, during a series of experiments, the acid become exhausted it can be withdrawn, and re-placed by other acid with the utmost facility; and after the experiments are concluded, the great advantage of easily washing the plates is at command. And it appears to me, that in place of making, under different circumstances, mutual sacrifices of comfort, power and economy, to obtain a desired end, all are at once obtained by Dr. HARE's form of trough.\*

The effects of the following circumstances are examined by Prof. Faraday under the new light thrown by his researches.

1. *Nature and Strength of Acid.* Nitric acid evolved no hydrogen, muriatic acid but little, and sulphuric acid most. They gave respectively for the equivalent of water decomposed, 1.85 eqs. of zinc for each plate, 3.8 eqs. and 4.66 eqs. by a mixture of 1 of acid to 200 parts of water. By adding to the mixture of water and sulphuric acid in proportions just referred to, 4 of nitric acid, the consumption of each zinc plate was reduced to 2.786 for each equivalent of water; 8 of nitric acid gave 2.26 eqs.; 200 water, 16 muriatic acid, and 6 nitric acid gave 2.11 eqs. per plate. This effect does not depend upon the strength of the acid solutions, the results being stated in equivalents.

2. *Uniformity in the strength of the charge,* is of great importance.

\* A practical difficulty suggested by Prof. Faraday, of making a wooden trough tight under the frequent alterations of dryness and moisture, is entirely overcome by using a coating of cement in the interior as in the trough made by Dr. Hare. Cement duly applied will render unnecessary the glass sides proposed by Prof. Faraday, to prevent discharges from the edges of the plates. B

3. *Purity of the zinc* is of great importance, its impurities making the action of the battery local.

4. *Foulness of the zinc plates*, interferes materially with the action of the battery. No old charge containing copper should be used.

5. *New and Old Plates*. The former are much the most efficacious. But after a few immersions the power of rolled zinc plates becomes nearly constant. This is not the case with cast zinc plates.

6. *Vicinity of the Copper and Zinc*. When the plates are at a less distance the facility of transference is increased. The intensity and quantity of the transferred current, are both increased for a given consumption of zinc.

7. *First immersion of the Plates*. This effect, independently of the newness of the plates, is produced by the mixture of the acid in the charge with that which has been neutralized. Hare's form of trough secures this advantage.

8. *Number of Plates*. The most advantageous number depends, mainly, on the resistance to be overcome in the decomposition, but the number admits, in any given case, of a maximum.

9. *Large or Small Plates*. The use of them will depend upon the facility of the transfer of electricity. If the most advantageous number is found, additions of zinc should be made to the size. Increase of size will raise the most advantageous number.

10. *Simultaneous decompositions*. When the number of plates exceeds the most advantageous number, more than one decomposition may be made with advantage.

The conducting power of the body to be decomposed, of course, materially modifies the results obtained. The enlargement and proximity of the poles, and conducting power of the liquid, should be particularly attended to in the construction of the volta-electrometer.

*Recent Researches on Heat*. M. MELLONI'S RESEARCHES.—Though the "thermo-multiplier" of M. Melloni has now been for several years before the scientific world, it is not yet perhaps so generally known to experimenters as it deserves to be. We shall deem it, therefore, not inappropriate to the nature of this article, to state briefly its principle.

The essential part of it consists in a great number of pairs of small slips of antimony and bismuth soldered together, and combined in one case, so as to have their galvanic action excited by the application of heat. This thermo-electric effect is indicated and measured by its influence on a magnetic needle, placed below, and arranged as a galvanometer, by having many coils of wire passed round it, the wires communicating with the thermo-electric combination; the effect is increased in proportion to the number of pairs of plates. Thus the *galvanic* action on the *needle* is the measure of the amount of *heat* affecting the metallic combination; and the important and valuable part of the contrivance is, that degrees of heat, so small as to be quite insensible to the most delicate thermometers, are *multiplied*, as it were, by the multiplication of the number of pairs of metal plates, and thus produce a sensible effect on the galvanometer needle. The skill of artists has been exercised in reducing them to small dimensions. M. Gourjon of Paris, has succeeded in bringing them into so small a compass, that the end of the case which is exposed to the heat, is not greater than the section of the bulb of an ordinary thermometer.

An instrument so far surpassing all formerly known in the sensibility of its indications, has, in the hands of its distinguished inventor, led to a series of results equally new and remarkable. A brief summary of some of the chief of them is as follows:

Radiant heat passes directly, in greater or less quantity, through certain kinds of solid and liquid bodies. This class of bodies does not precisely include those which are transparent, since some which are opaque, or very little transparent, are the most "diathermanous\*," that is, transparent, as it were, to *heat*. This term is one which M. Melloni has introduced as descriptive of the characteristic in question, and which we shall continue to use.

He concludes, in general, that there exist different species of heating rays; and that all these different kinds are emitted simultaneously from luminous hot bodies; though in different proportions from different sources, certain of them are entirely wanting in non-luminous hot bodies.

Rock-salt, cut into plates, and successively exposed to the radiations from different sources, transmits in all cases the same proportion of heat. Plates of any other diathermanous substance, under the same circumstances, transmit a less proportion of heat as the temperature of the source is less elevated; but the differences between one substance and another in this respect, diminish as the plate is of less thickness; whence it follows (according to M. Melloni) that the calorific rays from different sources are intercepted in a greater or less degree, not at the *surface*, or in virtue of an absorbing power which varies with the intensity, but in the *interior* of the plate, by a *peculiar absorptive force, which is analogous to that of coloured media for particular rays of light*.

M. Melloni advances several theoretical views in support of this analogy. He remarks, in general, that there is but one substance (*viz.* rock-salt) of all he has tried, which is transparent and uncoloured, and acts really in the same manner both on the rays of light and of heat. All others, though they allow all rays of light to pass indifferently, yet absorb certain rays of heat and transmit others. We thus recognise, by means of these bodies, a true distinction in heat corresponding to that of colour in light.

The colouring matter of transparent media always diminishes more or less their diathermanous properties, but gives them no peculiar property of stopping, by preference, any particular species of heating rays. It operates upon the transmission of radiant heat, as *brown* colouring matter (a smoked glass for instance) does upon light; that is, has only a general diminishing power on the intensity. There seems to be, however, an exception in regard to certain glasses coloured with green and with opaque black; but these two kinds of colouring matter only appear to act in modifying the quality of the diathermanous property.

Glass intercepts wholly certain species of heating rays, including all those which come from bodies below luminosity; hence, in this last case, no refraction by prisms or lenses has ever been effected for such rays of heat. With rock-salt, however, the case is different; and it is unquestionably the most singular and important of the facts elicited by Melloni, that simple heat is not merely transmitted through rock-salt, but absolutely *refracted* by it. He determined this both by a lens, and still more remarkably, by a prism of that substance.

With the prism interposed in the path of the rays coming from the source

\* From the Greek, *dia*, through; and *therman*, to feel heat.

of heat, the effect was no longer transmitted in a straight line, but made to undergo a considerable deviation by the action of the prism. This was observed to take place in different degrees, according to the nature of the source of heat. The greatest deviation took place when the flame of a lamp was employed; the next was incandescent platinum; the next with copper, at  $390^{\circ}$  centig., and when a vessel of boiling water was substituted, the effect was found too feeble to allow of any comparison with the other cases.

However, when the rock-salt was cut in the form of a lens, the concentration of the rays, even from boiling water, was sufficient to give a decided proof of their being really brought to a focus.

Questions relating to the *transmission* of radiant heat through different media, are those which have formed the principal subject of M. Melloni's inquiries. But he has also, in one instance, directed his attention to the equally curious and important question, of the relation of the state of the *surfaces and colour* of bodies to heat. The instance referred to is an examination of the *combination* of the effect of a *screen* with that of *surfaces*, the very same, in fact, which constitutes the experiment first proposed and tried by Mr. Powell, and published in the *Phil. Trans.* for 1825. This fundamental experiment M. Melloni has repeated, and has completely verified it with his extremely accurate apparatus; a confirmation the more valuable, as some previous experimenters, since the date of the publication of the original investigation, seem to have overlooked it. It decisively proves that that portion of the heat from a flame, which passes through a glass screen, is *also* distinguished from the part which is intercepted, by the additional characteristic of affecting a *black and a white* surface in a *different ratio*. This is an inquiry eminently deserving to be followed up by the same method, and to be extended to a long series of different sorts of coating applied to the thermometer or thermo-multiplier.

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*Polarization of Heat.* PROFESSOR FORBES.—M. Melloni failed in obtaining any detection of the effects due to the *polarization of heat*, which had been originally stated by M. Berard, though subsequent inquirers had been unable to discover any traces of it.

That zealous and highly-talented experimentalist, Professor Forbes of Edinburgh, here took up the subject. We believe we may say he was the first to introduce the use of Melloni's instrument into Great Britain. He has certainly employed it with signal success. Of such delicate inquiries as those respecting polarization, involving, in fact, complicated arrangements, which could hardly be made intelligible without lengthened details, it would not be possible to speak, in so rapid a sketch as the present, in a way to do them justice. But we must mention, however briefly and imperfectly, the valuable conclusion to which Professor Forbes's labours have led. In an elaborate and masterly paper in the *Edin. Trans.* (vol. xiii.), he has detailed these important researches. The analogies afforded by the polarization of light, led him to expect the most probable method of succeeding in the use of piles of mica; and the result fully justified his expectations.

Two piles of plates of mica were placed obliquely in the path of the rays, so that the inclination was that of the angle requisite for polarization. In such an arrangement, it is well known that in one position of the second pile all light is stopped. The same was found to be true of heat; not only from flame, but even from non-luminous sources. This was not all; as in light, the interposition of a plate of crystal between the two parts of the appara-

tus just described, *restores* or is said to *depolarize*, the light, so it was found to do with heat. On the principles of the undulatory theory this is explicable, and even subject to calculation in regard to light: by showing that a similar calculation will apply, Professor Forbes has rendered it in the highest degree probable that the same theory will hold good for heat; and has even pointed out the principle for calculating the lengths of the undulations necessary to be supposed, which he shows will be *greater* than those for light. This exactly accords with Melloni's result of their being less refrangible. Lond. Mag. Pop. Sc., April.

*Keith Medal to Professor Forbes.* The Council of the Royal Society of Edinburgh, have awarded this medal to Prof. Forbes, for his experiments demonstrating the polarization of light. The Vice President, in his address on the delivery of the medal, announces that Prof. Forbes has succeeded in producing the circular polarization of heat, the first public announcement of this new result. Ibid, Address of Vice Pres. Doct. Hope, &c.

*On the Prismatic Decomposition of Electrical Light.* By Prof. WHEATSTONE. The following is a brief notice of the principle results stated in this communication: 1. The spectrum of the electro-magnetic spark taken from mercury consists of seven definite rays only, separated by dark intervals from each other; these visible rays are two orange lines close together, a bright green line, two bluish green lines near each other, a very bright purple line, and lastly, a violet line. The observations were made with a telescope furnished with a measuring apparatus; and to ensure the appearance of the spark invariably in the same place, an appropriate modification of the electro-magnet was employed. 2. The spark taken in the same manner from zinc, cadmium, tin, bismuth, and lead, in the melted state, gives similar results; but the number, position, and colours of the lines vary in each case; the appearances are so different, that, by this mode of examination, the metals may be readily distinguished from each other. A table accompanied the paper, showing the position and colour of the lines in the various metals used. The spectra of zinc and cadmium are characterized by the presence of a red line in each, which occurs in neither of the other metals. 3. When the spark of a voltaic pile is taken from the same metals still in the melted state, precisely the same appearances are presented. 4. The voltaic spark from mercury was taken successively, in the ordinary vacuum of the air-pump, in the Torricellian vacuum, in carbonic acid gas, &c., and the same results were obtained as when the experiment was performed in the air or in oxygen gas. The light, therefore, does not arise from the combustion of the metal. Professor Wheatstone also examined, by the prism, the light which accompanies the ordinary combustion of the metals in oxygen gas and by other means, and found the appearances totally dissimilar to the above. 5. Fraunhofer having found that the ordinary electric spark examined by a prism presented a spectrum crossed by numerous bright lines, Professor Wheatstone examined the phenomena in different metals, and found that these bright lines differ in number and position in every different metal employed. When the spark is taken between balls of dissimilar metals, the lines appertaining to both are simultaneously seen. 6. The peculiar phenomena observed in the voltaic spark taken between different metallic wires connected with a powerful battery were then described, and the paper concluded with a review of the various theories which have been advanced to explain the origin of electric

light. Professor Wheatstone infers from his researches, that electric light results from the volatilization and ignition (not combustion) of the ponderable matter of the conductor itself; a conclusion closely resembling that arrived at by Fusinieri from his experiments on the transportation of ponderable matter in electric discharges. *Trans. Brit. Assoc. Lond. and Edin. Phil. Mag.*

*Kater's Portable Altitude and Azimuth Circle.* An account of the performance of a small circle of this kind in the hands of the inventor, is given by Mr. Galbraith. The arch is of but three inches radius. By eight observations the latitude of Capt. Kater's house was determined within about 4.8 seconds of what was considered to be the true latitude, having been obtained by more powerful instruments. Mr. Galbraith speaks of a six inch circle of his own, with a telescope magnifying about twenty times and with three verniers to each of the circles. The level is divided to three seconds. Accounts of the satisfactory performance of his instrument are given.

*Jameson's Journal*

*Supposed discovery of a new small Planet.* This discovery M. Cacciatore, director of the Observatory at Palermo, supposes he has made. He has not as yet succeeded in establishing it definitively. *Ibid.*

*Heat conveyed by Springs.* Professor Bishoff gives a number of examples in which the temperature of the interior of the earth is brought to the surface by springs, and others in which, taking their rise in cold situations, the springs bring with them to a considerable distance the low temperature of their origin. Thirteen fresh water springs near the glaciers of the Tyrolese Alps, and in the limit of their snows, had a temperature from  $36\frac{1}{2}^{\circ}$  to  $43\frac{1}{4}^{\circ}$  Fah. Some fresh water springs at the foot of the upper glacier near Grindelwald in Switzerland, had a temperature of between  $37\frac{1}{2}^{\circ}$  and  $38^{\circ}$ . The springs on St. Gothard 3587 feet above the level of the sea, were found by Wahlenberg and Van Buch, to have a temperature of  $37\frac{1}{2}^{\circ}$ .

On the contrary, four springs at the foot of the Great Eiger in Switzerland, had only a temperature of  $42\frac{3}{4}^{\circ}$ . Van Buch found a spring near Neufchatel of which the temperature was only  $40\frac{1}{2}^{\circ}$ , while the neighbouring springs were from  $50^{\circ}$  to  $50\frac{1}{2}^{\circ}$ . *Ibid.*

*Relative level of Caspian Sea and of the Ocean.* The supposed existence of a region of dry land 18,000 square leagues in area, surrounding the Caspian Sea, and below the mean level of the ocean, has naturally excited the most lively curiosity. The fact was regarded for twenty years as established by a series of barometrical measurements made in 1811 by Professors Engelhardt and Parrot. The difference of level which these travellers assigned to the Caspian and the Black Seas amounted to about 350 feet. But Professor Parrot, having revisited the tract in 1829 and 30, soon found reason to doubt the accuracy of his former conclusions. He learnt that some Russian engineers had ascertained by careful measurements that the Don, at the place called Katschalinsk, where it is only sixty wersts distant from the Wolga, is 130 Paris feet *higher* than the latter river, and as the Don flows with much greater rapidity to the Black Sea than the Wolga does to the Caspian, the difference of level between the two seas, if any, must be considerably less than 130 feet. Parrot accordingly made a series of levelings from the mouth of the Walga to Zarytzin, 400 wersts up its course, and from the mouth of the Don to the like distance; and these observations gave as a result that the mouth of the Don was between three and four feet *lower* than that of the Wolga! So that, according to this measurement, if there is any difference between the levels of the two seas, the Caspian is the higher!

*Address of Pres. Lyell to Geolog. Soc. and Lond. and Edin. Philos. Mag.*

*Effect of Forests upon the Temperature.* A motion has been lately made in the Chamber of Deputies for the general clearing of the woods in France. M. Arago showed that the clearing of extensive woods may be attended with effects of various kinds—the climate may be affected in many ways. He proceeded:—"To form a mean temperature in a given climate, there may be a very unequal distribution in the monthly temperature: it is from hence that Buffon conceived the idea of distinguishing temperate climes, from excessive ones. The climate of North America is now severe—that of Europe was equally so before it was cleared of forests. At those early periods the winters were much colder, and the summers much warmer than at present. You will perhaps be surprised to hear that a few centuries ago the summer heat in the vicinity of Paris was much greater than it is in our own times. This is a fact, however, which is proved by various documents; among others, by a charter allowing the vine-growers of Amiens to compete with other districts of France, for the honor of supplying the most perfect wines to the table of Philip Augustus. I do not suppose that any vine-growers of Amiens, at the present day, would set up the pretension of being able to supply the best wine to any one.

"A very extensive modification has occurred in the climate of that region of France—it has been the necessary consequence of clearing the woods."

Lond. Jour. of Arts, April.

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## **Progress of Civil Engineering.**

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*Report of E. F. Gay, Engineer on the Columbia and Philadelphia Railway, upon Motive Power.*

*To the Board of Canal Commissioners of Pennsylvania:*

GENTLEMEN—Having made report to the superintendent relative to the construction of works done, or contemplated to be done, on the railway, I proceed to comply with the further instructions of your secretary, by reporting to you the situation of the line, and the motive power upon it.

The superstructure of the railway has continued in an excellent condition during the past season; indeed, with the exception of the north track, on the eastern twenty-two miles of the road; (which is constructed chiefly of wood,) the permanent character of the railway is a sufficient guarantee that few repairs of importance will be required on it for many years to come. The substructure of the road is generally of a solid and substantial character; the viaducts are the only works which are liable to injury from the heavy travel over them. Three of the piers to the Little Conestoga viaduct, and one at Mill Creek, have been badly fractured, as they were defective in their original construction; they have, however, been properly secured with buttresses, and may now be considered in a safe condition. It is probable that one other pier at Mill Creek viaduct will require the support of buttresses in the course of another summer, which work the supervisor has included in his estimate for repairs. All the other viaducts are in a good condition. As the fears of the traveling community have been frequently expressed in relation to the danger of these viaducts taking fire from the sparks emitted from the chimneys of the locomotives, it may be proper for me to remark that little fear need be entertained of fire from such a cause; this may be inferred from the fact that the cool atmosphere in the viaduct condenses the steam as it escapes from the exhaust pipes, and so

moistens the surface exposed, as to prevent ignition from the sparks; indeed, so rapidly does the steam condense during very cold weather in winter, that the water falls in drops from the interior of the bridge roof. Coals have sometimes fallen from the ash-pan of the engine on the floor of the bridge; any danger, however, from this source, is obviated by a slight coating of gravel distributed over the exposed surface. Confidence, it is believed, may therefore be justly entertained, that so great a calamity as the destruction of one of these viaducts by fire need not be apprehended from the use of locomotive engines upon the road; yet it is by all means important that a watchful eye should continually be kept over them.

The inclined planes are, and have continued during the past season, in excellent condition. I am happy to state, that in the ordinary operation of ascending and descending the plane with the aid of the machinery, not a single accident of a serious nature has occurred during the past year. The operation of the planes is, however, always attended with more or less delay, particularly in damp weather when the adhesion of the rope is diminished, and the detensions which occur are exceedingly annoying to travellers, *the fault-finding part of whom*, without stopping to inquire the cause, do not hesitate loudly to attribute it to the mismanagement of the public agents. So much has been said about the construction of railways to avoid the Schuylkill and Columbia inclined planes, that I was last summer induced to make a cursory examination, with a view to ascertain the fall and distance from a point on the railway near the Spread Eagle crossing, in Radnor township, by way of the Gulf Valley to the Schuylkill, thence along the Schuylkill to the west end of the viaduct at the foot of the inclined plane. This distance is found to be fifteen and one quarter miles, (about two miles further than by the present railway,) and the fall three hundred and eighty-one feet, being at the rate of twenty-five feet per mile. I did not, however, trace the line over the ground upon which the railway would be located, neither did my limited time allow me to take any notes with a view to estimate the cost of a railway upon that route; but, from general observation, I am of opinion that the undulating character of a large portion of the line would render the grading of a railway upon it decidedly expensive; it is, however, by no means impracticable, and is certainly worthy of a more minute examination. At the request of the citizens of Columbia, I have also made an examination, with plans, estimates, &c., of a line of railway to avoid the Columbia inclined plane; this line commences near the village of Mount Pleasant, and, passing down the valley of Strickler's run, crosses the present railway near the foot of the inclined plane, at an elevation of about twenty feet above the track, and enters Front street, in which it was designed to be continued to the basin; the whole distance of five and one quarter miles being not more than one-third of a mile longer than the present line, and the graduation will not exceed thirty-four and a half feet per mile. The grade, however, can be reduced to thirty-three and one-third feet per mile, and a superior line be obtained, by keeping to the east of Front street after crossing the railway, and passing through what has been commonly termed the alley route, which will intersect the present railway on the east side of the basin, thereby affording additional facilities for the transaction of business. The grade, although higher than desirable, yet being within the limits of locomotive power, is deemed so much superior to the present arrangement, as to justify the opinion that the charge is well worthy being recommended to the serious consideration of the legisla-

ture. The estimated cost of this change, if the rails are removed from the present line, is \$110,000; or, if laid with a new wooden track, \$133,360.

### *Motive Power.*

At the date of my last annual report, two locomotive engines, viz: the Lancaster and Columbia, were in successful operation upon the line, and thirteen others had been contracted for, the most of which were expected on the road early in the spring. This anticipation, however, was not realized, as but seven engines were in readiness to meet the demands of the spring trade, since which time the number has gradually increased to seventeen, viz: ten manufactured by M.W. Baldwin, Esq.; five by Robert Stevenson of England; one by Coleman Sellers & Sons; and one by Long & Norris, the latter two have been but recently put upon the road, and their capacity is not yet fairly tested; they are, however, believed to be excellent engines. The engines from Mr. Baldwin have all been tested, and found to be of the first class. The five engines imported from England, are not so efficient as those manufactured in this country; the workmanship of them is good, but many important parts of the machines are too light to enable them to encounter (with a heavy load) the higher grades and severe curves on this railway; in consequence of which, frequent repairs are required upon them. These engines were not obtained from England, (as has been generally supposed,) with the view of getting *better* engines than could be procured in this country, but simply because locomotives could not be manufactured here, fast enough to meet the wants of the road. My own opinion has always been in favour of encouraging the mechanics of our country in the manufacture of engines. Nothing but a suitable degree of encouragement is wanting to arouse the native enterprise of our mechanics to this important branch of business; and locomotive engines brought from England to this country for sale, will most assuredly find a *bad market*.

There are not at present a sufficient number of engines on the road to meet the current demands of the trade, as in consequence of repairs required, not more than two thirds of the number on the road can be kept in readiness for actual service. This deficiency will, however, be in a great measure diminished, whenever duplicates can be obtained for such parts of the engines as are most liable to injury, and workshops can be properly arranged to do the repairs without the loss of time. Indeed, the want of suitable workshops, during the past season, to do the repairs promptly, has materially lessened the amount of available power on the road. It may be asked, "Why these workshops were not built"? To this I can only reply, that it was last year contemplated to erect additions to the shop at Columbia, so as to do all the repairs at that end of the road; but before funds were provided for the prosecution of the plans proposed, the rapidly increasing trade on the road suggested the propriety of selecting a more central position on the line for their location. It was therefore, thought most prudent to defer the matter for a month or two, that the proper point might be more clearly indicated, by the running of the engines. After due consideration of all the advantages and disadvantages, which seemed to have a bearing on the subject, it was early in July decided to erect the workshops, necessary to do all the repairs upon the road, at Parkesburg, being the point selected for the junction of the Oxford railway and the state works. This position embraces many advantages: such as being very nearly central; it is healthy, and has an excellent spring of running water for the supply of the engines. It may be proper here to remark, that a donation of

all the ground required for the accommodation of the workshops, together with a lot for a collector's office, has been made to the commonwealth, by the owner, Mr. Parke. The depot and workshops are now finished, and in readiness for the reception of the tools, and machinery, which are in a state of preparation, and will probably be completed during the present month. It is to be regretted that the want of funds has not allowed the erection of the necessary dwellings, for the workmen connected with the shops, as boarding is difficult to be obtained in the vicinity, which will of course interfere with any system that may be adopted for the repairs, until an appropriation shall be made for the necessary buildings. When this is done, and the buildings completed, a proper degree of economy can be preserved in this important branch of the establishment. The engines upon this road have generally performed their trips with great regularity; and it affords me pleasure to add, that the American engines, delivered within the present year, are capable of doing more work than was estimated in my last report: the most of them, in their ordinary trips, draw a gross load of seventy-five tons. The engine Schuylkill has drawn over the road a gross load of *one hundred tons*, and several others have drawn, over the highest grade, from eighty to ninety tons gross. When the curves and grades upon this road are taken into consideration, it is believed that the performance of these engines will be found equal to any in America. It is also gratifying for me to be able to state, that most of the prejudice which existed along the line against the use of locomotive engines last year, appears to have vanished, and in its place has arisen a prepossession in their favor: this however, is nothing more than might reasonably have been expected, for certainly no intelligent individual can witness the performance of a single engine, drawing a train of fifteen cars, loaded with three tons each, from one inclined plane to another, (seventy-seven miles,) in eight hours, without honestly acknowledging the decided superiority of steam over horses—at least so far as its application to railways.

Of the twenty locomotives authorized to be obtained for this railway, seventeen (as has been previously stated) are upon the road, and the remaining three will probably be put on during the present month.

The cost of twenty engines, complete, will be	\$126,000
Average cost of each,	6,300

As no separate account was kept, by the collectors, of the motive power received prior to the first of January last, and as all the expenses of that branch of the establishment were paid out of the construction fund up to the 1st of February, I am not able to furnish a comparison of the receipts and expenditures for motive power, previous to the latter date. The following statement will, therefore, exhibit its income and cost for nine months, commencing February 1st, and ending November 1st.

Amount received by collectors for motive power,	\$ 46,514 98
Expenditures and debt, (see supervisor's report,)	45,431 75

Excess of receipts over expenses,	\$ 1,083 23
to this is added the excess of stock on hand over last year,	4,455 30

The actual excess over cost will stand,	\$ 5,538 53
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Or, if from the expenditures,	\$ 45,431 35
Be deducted stock on hand over last year,	4,455 30

The actual cost for motive power, for nine months, will stand, \$40,976 45  
Or, average cost per day, - - - - - 150 00

It is believed, that the receipts and expenditures of the ensuing year will be at least double the amount of the last year; but, as with the present tolls they would probably progress in nearly the same ratios, the preceding result will afford safe data to estimate the value of the motive power to the commonwealth. Taking, therefore, ten engines as the average number upon the road during the past season, the cost of which, at six thousand three hundred dollars each, would be sixty-three thousand dollars—

Interest of which is - - - - - \$ 3,150 00  
Deduct above interest from surplus receipts and stock on hand, 5,538 53

Balance left towards refunding the principal, - - - \$ 2,388 53

This, it is evident, will not be sufficient, as the durability of an engine will probably not exceed four, or, at furthest, five years, which would render an amount of fourteen thousand dollars per annum necessary to replace the engines, or about eleven thousand six hundred dollars more than the surplus of the present year, to each ten engines. It is believed, however, that a large portion of this amount would have been received during the past year, if all the tolls from passengers traveling on the road had been collected; but as this evidently had not been done, in order to remedy the evil, I would recommend that a careful and attentive agent of the commonwealth should be placed on each line of passenger cars, whose duty it shall be to keep a way-bill, in which he shall note the number of passengers in each car, and the distance traveled by them—and who shall also see that the conductors of each car, or train of cars, keep a like way-bill, upon which the names of all the passengers should be entered.—This plan, it is believed, would soon ensure an important increase to the revenues of the commonwealth. In order, however, to aid still further in obtaining a surplus fund for the renewal of the engines, I would suggest the propriety of increasing the toll, for motive power, on each passenger, to one cent per mile. This change would probably, in connexion with the appointment of agents to keep way-bills, ensure a sufficient revenue to meet all demands upon the road for motive power.

In the following estimate of the amount required for motive power, during the ensuing year, I have endeavored to include every expense that can be anticipated. It is still probable, however, that the rapidly increasing trade, on this great thoroughfare may require additional expenditures, which cannot, at this time, be foreseen, but which may be found absolutely necessary before, in the ordinary course of business, a second legislature could act upon them. It seems to me, therefore, highly important that some especial fund should be provided, by which (if necessary) the agents of the commonwealth could meet any extraordinary demand upon the motive power, such as the opening of other railways, which connect with the Columbia line, and which being in the progress of construction, would create.

*Estimated amount required for the ensuing year.*

Fifteen additional locomotive engines and tenders, at \$6,400,	\$96,000
One stationary engine for workshop, - - - - -	2,000
Tools, machinery, &c., for same, - - - - -	4,000
Additional water stations, reservoirs, &c. - - - - -	1,800
Turn-outs, crossings, swivels, &c. - - - - -	1,500
Sheds for night stands, at water stations, - - - - -	2,000

Additional set of ropes at inclined planes,	-	-	-	3,000
				<hr/>
				\$110,000
If no arrangements should be made with a view of avoiding the planes, a second set of stationary engines will be required, which, with their erection, will cost,	-	-	-	16,000
To which should be added the covering of the planes, recommended in my last report,	-	-	-	25,000
				<hr/>
			Total,	\$156,000

Having in previous reports expressed my opinion in relation to the manner of using this railway, I deem further remarks on that subject unnecessary. The cars being at present owned by individuals, are generally kept in good condition, and owners appear uniformly well disposed toward making such repairs, or alterations, as they are from time to time directed to make.      \*      \*      \*      \*

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*M. Brunel's mode of constructing arches without centering.* The principle, which was originally adopted, and its efficacy ascertained, in the formation of the shaft of the Thames Tunnel, is founded upon the cohesive power of Roman cement, coupled with a system of ties, the most eligible substance for which, from a series of experiments performed by M. Brunel, appeared to be hoop iron. The piers having been constructed in the usual manner, it is proposed to pin, or secure, to them a mould for the purpose of determining the contour of the arch. A narrow rib may now be carried over, and keyed, using cement (with the occasional insertion of ties), which, by its adhesion to the brick being greater than the cohesion, enables the arch to be carried to any extent within the limits of the strength of the material. The several arches being in succession, once keyed, they will be in a state to receive the whole of the materials necessary to the completion of the bridge.

The bridge of the Santissima Trinitá at Florence was particularly adverted to, as affording a magnificent example of rubble construction, and the durability of the material. The arches are composed of a mass of irregular stones embedded in mortar, having the consistence of a single stone, or of two stones abutting against each other at the crown.

Lond. Archit. Mag., April.

*Cast and Wrought-Iron Wheels.*—It was stated at a meeting of the Institution of Civil Engineering, that where cast-iron wheels on rail-ways would only last six or eight months, wrought-iron would serve at the same work three or four years.

The wear of the Manchester and Liverpool line was stated to be 1-20th of an inch in depth per annum. The flanges rarely come into contact with the rails; one of the oldest wheels being taken off a carriage, the marks of the turning tool was found on the flange.

Lon. Mech. Mag.

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## Mechanics' Register.

### INVENTION OF THE MARINER'S COMPASS.

The invention of this precious instrument has hitherto been awarded

to Favio Gioia, a Neapolitan, in 1302, or 1303. But this statement has rested on no satisfactory evidence; and, when it was discovered that the Chinese and Arabian authors had spoken of the magnet's polarity before the fourteenth century, it began to be suspected that the Neapolitan was merely the introducer of the compass into Europe. To settle the question, in January, 1834, Baron Humboldt wrote to M. Klaproth to ascertain the epochs,—1st. When the Chinese discovered the polarity of the magnet; and, 2d. When they began to apply it to the purposes of navigation. M. Klaproth has replied in a work, published in Paris towards the close of the year, in which the most remarkable proof of the Chinese claims to this invention, is in the history of the magnetic chariots, whose origin is lost in the obscurity of the mythological ages. The accompanying representation of one of these chariots is taken from the 33d volume of *Japanese Encyclopædia*.

The figure in front of the chariot was made of some light material; it was fixed upon a pivot, and its finger invariably pointed to the south, which, as we have already said, was the *kibleh*, or sacred point of the Chinese, to which they always turn when performing their devotions. It is intimated rather obscurely, that these magnetic chariots were first invented for a religious purpose, namely, to enable the devout to discover their *kibleh* when the sun and stars were obscured by clouds—a purpose to which the compass is frequently applied in the present day by Mohammedan nations; but there are very full descriptions of the use made of these chariots in directing the march of armies, and guiding ambassadors. M. Klaproth has collected, from Chinese authorities, many curious anecdotes of the use made of these chariots; under the Tsin dynasty they formed a part of every royal procession. In the *Tsin-tchi*, or history of that dynasty, we find—"The wooden figure placed on the magnetic car resembled a genius wearing a dress made of feathers; whatever was the position of the car, the hand of the genius always pointed to the south. When the emperor went in state, one of these cars headed the procession, and served to indicate the cardinal points."

In the history of the second Tchoa dynasty, which lasted from A. D. 319 to A. D. 351, we read,—“The Chang-Fang (president of the board of works) ordered Kiai Fei, who was distinguished by his great skill in constructing every kind of instrument, to build a number of magnetic chariots, which were sent as presents to the principal grandees of the empire.” There are several accounts of the manner in which the magnetic figures were constructed: as our readers have probably anticipated, a magnetized bar passed through the arm of the figure; and the only



(Magnetic Chariot.)

variety of ingenuity displayed by the architects was in balancing the figure upon its pivot.

The antiquity of these magnetic chariots is established incontrovertibly; the step from them to the compass is so very easy, that we may safely assert that the one must have led immediately to the other.\*

*Arcana of Science for 1835.*

*The Bude Light* is a name given by M. Gurney (of steam carriage abolition celebrity) to a new light which he has discovered, and so named, after his new place of residence in Cornwall. It is obtained by directing a stream of oxy-hydrogen gas on a quantity of pounded egg-shells.

*Mech. Mag.*

*Query.* In what does this differ from the well known light by a stream of wind, oxygen and hydrogen gases, on lime? The egg-shells will first be reduced from the state of a carbonate to nearly pure lime.

*The Freyberg Suspension-Bridge.*—We regret to learn, from a friend who has just returned from Switzerland, that, in consequence of some symptoms of insecurity exhibited by the suspension-bridge at Freyberg, the local authorities have ordered it to be stopped up for the present. *ib.*

*Paving with Wood.*—The editor of the London Architectural Magazine, makes the following statement in relation to wooden pavements in Russia.—

The trunks of trees, from 9 in. to 1 ft. in diameter, are cut into lengths of from 12 in. to 18 in., deprived of their outside or sap wood, then squared, and afterwards set on end as common paving stones are in London. The courts of the larger mansions in Petersburg, Moscow, and Vienna are frequently paved in this manner, not for the sake of durability, nor for any reasons of economy, but simply to lessen the noise made by the wheels of carriages, when coming to set down or take up company.

*Lond. Arch. Mag.*

*The Bell Rock Light-House* has suffered greater damage during the severe gales of the last autumn and winter than at any time since its erection. The spring tides in January rose to 116 feet, and drifted over the building; while, on ordinary tides, 19 feet is the extent of their rise. The heaviest ground-swell preceded the heaviest wind by two days. Some large rocks, called "travellers," were thrown up against the foundation of the light-houses, weighing about five tons!

*Lond. Mech. Mag.*

*Drilling Holes in Glass.*—A method of boring glass with a drill dipped in spirits of turpentine, has been introduced from Paris. A bow and steel drill kept moist with the spirit, rapidly drills a smooth hole through glass of any thickness; I have drilled a hole through the thick bottom of a tumbler with a broken triangular file in a very short time. The drill is not blunted more than it would be by piercing iron of the same thickness.

*A. Trevelyan, in Lond. Mech. Mag.*

*Iron Steam Boat.*—The Alburkha was built at Liverpool by Messrs. M'Gregor, Laird, & Co. Her dimensions are—"Length 70 feet; beam, 13 feet; depth, 6 feet 6 inches; tonnage, including engine-room, 56; draught of water, with engine, coals, and water in boiler, 2 feet 9 inches; with provisions, water, &c., for her voyage to the Niger, 4 feet 6 inches. The bottom and sides of this vessel are composed of iron plates, the former, five-sixteenths of an inch thick, the latter, a quarter of an inch: engine fifteen horse power. All accounts that have been received from this vessel, agree that she is much cooler and drier, and, of course, more healthy, than a vessel built of wood; that she is an excellent sea boat."

*Nautical Magazine, vol. II. p. 678, and Arcana of Science for 1835.*

*List of American Patents which issued in April, 1836.*

	<i>April.</i>
274. <i>Cutting saw teeth.</i> —Samuel G. Merriman, Southington, Conn.	11
275. <i>Furnace for smelting.</i> —Arundius Tiers, Kensington, Penn.	11
276. <i>Boats and rafts, passing, &amp;c.</i> —Benning Sanborn, Lyman, N. Hampshire,	11
277. <i>Corn and cotton planter.</i> —George C. Boyd, New London, Penn.	11
278. <i>Soda Fountains.</i> —R. Boston and T. Bryan, N. York,	11
279. <i>Saw mill.</i> —Daniel Gerrish, Boston, Mass.	11
280. <i>Saw mill blocks.</i> —Erastus Rathburn, Coneaut, Ohio,	11
281. <i>Bake oven.</i> —Eben B. Strong, Buffalo, N. Y.	11
282. <i>Water wheels, &amp;c. for mills.</i> —John T. Towne, Mount Morris, N. Y.	11
283. <i>Serving ropes.</i> —Charles Parke, N. Y.	13
284. <i>Sacking bottom, &amp;c.</i> —L. L. Wells, Middletown, Conn.	13
285. <i>Brick machine.</i> —Nathaniel Adams, Newburg, N. Y.	13
286. <i>Hats, napping, &amp;c.</i> —L. Lyon, 2nd. Needham, Mass.	13
287. <i>Coffee mills.</i> —C. W. Peckham, New Haven, Conn.	13
288. <i>Door lock.</i> —Benjamin Smith, Canton, Conn.	13
289. <i>Cotton seed huller.</i> —Peirson Reading, Trenton, N. J.	13
290. <i>Cotton gin.</i> —Peirson Reading, Trenton, N. J.	13
291. <i>Mortising and boring machine.</i> —George Page, Keene, N. H.	13
292. <i>Cooking stove.</i> —Charles Vale, Newark, N. J.	13
293. <i>Hydrostatic press.</i> —Thomas Baxter, Petersburg, Va.	13
294. <i>Bed, spiral spring.</i> —M. T. Moody, and B. Eastman, Northampton, Mass.	13
295. <i>Pistols.</i> —Bond B. M. Darling, Billingham, Mass.	13
296. <i>Spark Extinguisher.</i> —James F. Curtis, Boston, Mass.	13
297. <i>Mortising timber.</i> —George Page, Keene, N. H.	21
298. <i>Glass cases.</i> —Thomas W. Whitty, Patterson, N. J.	21
299. <i>Brick machine.</i> —Gooding Holloway, Montgomery county, Penn.	21
300. <i>Corn husks, slitting.</i> —Asa Bonett, Baltimore, Md.	21
301. <i>Churn.</i> —Charles Merriman, Middletown, Conn.	21
302. <i>Washing machine.</i> —Charles Merriman, Middletown, Conn.	21
303. <i>Stove for carriages.</i> —Alexander McWilliams, Washington city,	21
304. <i>Washing machine.</i> —Henry Souder, Strasburg, Penn.	21
305. <i>Harrow.</i> —J. C. Conklin, Peekskill, N. Y.	21
306. <i>Shingles, dressing.</i> —N. P. Hawk and J. Keyes, Union, N. Y.	21
307. <i>Sawing wood.</i> —Jos. Pinneo, Jr. Hanover, N. H.	21
308. <i>Ice cutting machine.</i> —Samuel Trask, Hallowell, Maine,	21
309. <i>Straw cutter.</i> —James M. Wolfolk, Oldham co., Ken.	21
310. <i>Plough.</i> —John Farlee, Mercer co., Ken.	21
311. <i>Ores and sweepings, washing.</i> —William Davis, city of N. Y.	28
312. <i>Paddles for boats.</i> —John Cochran, Baltimore, Md.	28
313. <i>Bedstead fastenings.</i> —John McLaughlin, Sunderland, Vt.	28
314. <i>Thrashing machine.</i> —Hugh Barclay, Lexington, Va.	28
315. <i>Saw mill.</i> —James Sanders, Alleghany co., Md.	28
316. <i>Stoves.</i> —Frazier H. Blanchard and B. Gill, N. Y.	28
317. <i>Cotton, condensing.</i> —Arlon Mann, Smithfield, R. I.	28
318. <i>Spring saddle.</i> —Peter Crim, Waynetown, Penn.	28
319. <i>Cooking stove.</i> —Jonas Kendall, Ipswich, Mass.	28
320. <i>Excavating from rivers, &amp;c.</i> —Silvanus Russel, Buffalo, N. Y.	28
321. <i>Smut machine.</i> —William B. Ryan, Mount Morris, N. Y.	28
322. <i>Window blind fastenings.</i> —Jonathan Bacon, Bedford, Mass.	28
323. <i>Carriage wheels, confining.</i> —Clark Force, Baltimore, Md.	28
324. <i>Rail road cars.</i> —Isaac Knight, Baltimore, Md.	28
325. <i>Lath machine.</i> —Elhu Smith, Ithaca, N. Y.	28
326. <i>Gimblets</i> —William M. Fowler, N. Branford, Conn.	28
327. <i>Boxes, fitting to wheels.</i> —J. and C. Putnam, Hallowhill, Maine,	28
328. <i>Shears for tailors, &amp;c.</i> —Richard Fitzgerald, Elizabethtown, N. J.	28
329. <i>Stoves.</i> —Frederick Frickhards, Easton, Penn.	28
330. <i>Leather rolling machine.</i> —J. McLaughlin and H. Hill, Sunderland, Vt.	28
331. <i>Plough.</i> —Nathan L. Koon, Sparta, N. Y.	28

## CELESTIAL PHENOMENA, FOR AUGUST, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.				
5	13	2	$\nu^1$ Tauri	,5,	119°	68°
5	14	1			288	233
5	13	38	$\nu^2$ Tauri	,6,	138	85
5	14	34			270	215
22	10	2	$\tau$ Sagittarii	,4,	123	137
22	11	11			258	285

## Meteorological Observations for April, 1836.

Moon.	Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
☉	1	39°	41°	30.10	30.05	E. SW.	Moderate.		Lightly cloudy—drizzle.
	2	38	54	29.90	29.85	SW.	do.		Cloudy—clear.
	3	39	59	29.80	29.80	NW.	Breeze.		Clear day.
	4	43	43	29.73	29.83	NW. NE.	Moderate.		Cloudy—drizzle.
	5	36	52	29.76	29.84	NW.	do.		Clear day.
	6	29	36	29.95	29.95	N.	Breeze.		Cloudy day.
	7	27	52	30.10	30.14	WSW.	do.		Clear day.
	8	31	54	30.10	30.10	SW. S.	do.		Clear—cloudy.
	9	53	72	29.84	29.75	S. W.	Brisk.		Cloudy—lightly cloudy.
	10	53	47	29.60	29.65	S. W.	Blustering	.15	Rain—frost—flying clouds.
	11	27	39	30.00	30.05	W.	do.		Clear—flying clouds.
	12	26	50	30.30	30.34	E. SE.	Moderate.	1.85	Clear day
	13	31	42	30.20	29.90	SE.	do.		Cloudy—hurry of snow—rain.
	14	41	55	29.52	29.55	W.	do.	.8	Clear—flying clouds—shower.
	15	35	49	29.75	29.75	W.	do.		Partially cloudy—flying clouds.
	16	35	55	30.03	30.11	W. SW	do.		Clear day.
	17	35	56	30.15	30.20	E.	do.		Cloudy—partially cloudy.
	18	48	61	30.00	29.86	SE. SSE.	do.	.16	Cloudy—rain.
	19	51	50	29.95	30.10	N. E.	do.		Rain—rain.
	20	46	62	30.15	30.24	NE. SW.	do.	.14	Cloudy—clear.
	21	47	61	30.04	29.84	E. S.	do.	.2	Cloudy—clear.
	22	38	48	29.84	30.0	W.	Blustering.	.15	Drizzle—lightly cloudy—rain.
	23	40	57	30.14	30.04	S. W.S.	do.		Clear do. brilliant aurora B.
	24	44	57	30.10	30.20	NW. W.	do.		Cloudy—flying clouds.
	25	34	61	30.40	30.36	NE. SW.	do.		Lightly cloudy—clear.
	26	48	76	30.02	29.82	S. W.	do.		Clear day.
	27	60	71	29.96	29.96	NW. W.	do.		Cloudy—hazy.
	28	49	74	30.20	30.20	NE. S.	do.		Clear day.
	29	56	71	30.10	30.00	SE. S.	do.		Clear—lightly cloudy.
	30	59	54	30.10	30.20	E.	do.		Cloudy—lightly cloudy.
	Mean	40.90	55.30	29.96	29.97			2.65	Cloudy—drizzle.

Thermometer.

Maximum height during the month, 76. on 26th.

Minimum do. 26. on 12th.

Mean 48.10

Barometer.

30.40 on 25th.

29.13 on 4th.

29.965

**JOURNAL**  
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**MECHANICS' REGISTER.**

DEVOTED TO  
**Mechanical and Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

AUGUST, 1836.

**Practical and Theoretical Mechanics.**

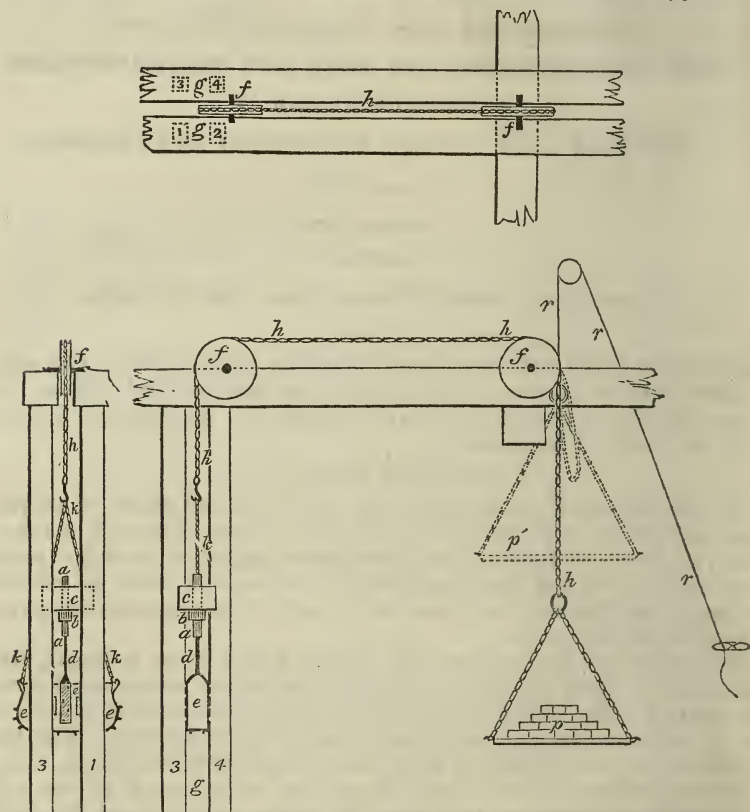
*Experiments on the resistance of sand to motion through tubes, with especial reference to its use in the blasting of rocks, made at Fort Adams, Newport harbour, under the direction of Col. Totten. By Lieut. T. S. BROWN, of the Corps of Engineers.*

(CONTINUED FROM p. 8.)

For the purpose of examining further the degree and nature of the resistance offered by sand when it is attempted to force it through a tube by direct pressure, the following apparatus was arranged, after a few preliminary trials, which had given some idea of the power it would be necessary to apply. A side and end view, and a plan of the apparatus are given in the cut on the next page.

The strong cast composition tube, *a*, about fifteen inches in length, which contained the sand, was held in a vertical position by being passed through the block, *c*. The pressure was always applied to the bottom, and the collar, *b*, cast upon the tube, prevented its being forced upwards. The block *c*, was secured in its place by being let into the four posts, 1, 2, 3, 4, passing from the floor to the ceiling. These four posts formed a very stable frame work, and between each pair, the space, *g*, permitted the sliding board, *e*, to move freely up and down, and secured the proper direction to the pressing force. For the sake of distinctness this space, *g*, has been represented wider on the sketch, and the sliding board, *e*, thicker, than they actually were. The pressure was applied by means of a movable piston within the tube, connected by means of the iron rod, *d*, with the sliding board, *e*. This sliding board was attached, by means of the chains, *k, k, h, h, h*, passing over the cast iron pullies, *f, f*, to the platform, *p*. Of course any weight placed on this platform communicated a corresponding pressure upwards to the piston within the tube. The chain *h, h*, was of the best

Peru iron;\* the wire was about  $\frac{1}{2}$  an inch in diameter, and the chain had been proved with 9 tons dead weight. The pulleys, *f*, *f*, were about a foot in diameter; and their axles were of wrought iron an inch and a half in diameter. When a dead weight was to be applied, the platform was loaded in the position, *p*, but if a violent shock was to be produced, the platform was held in the position, *p'*, by means of the cord, *r*, *r*, *r*, until it had received the proposed load; the cord, *r*, *r*, *r*, being then suddenly cast loose, permitted the loaded platform to fall freely by its gravity, until it had straightened the chain, when it was either entirely arrested by the resistance of the sand in the tube, or it forced its way to the floor in consequence of the yielding of the sand, or of the fracture of some part of the apparatus.



There were other minor details which it is not necessary to particularize. The fixtures were not brought to the degree of strength just stated until after many trials, and the repeated failure of nearly every part of the apparatus; and, as will be seen, a limit was soon attained, beyond which the experiments, even with this degree of strength, could not be carried. The weights used were bricks. The piston was so arranged as to move without friction when the tube was empty, and at the same time to prevent the escape of the sand when the tube was charged. Trials were made with sand poured loosely into the tube, and with sand carefully packed. The packing

\* Peru, Clinton county, New York. The iron from this locality possesses a remarkable degree of tenacity.

was performed by means of a small sharp stick which was worked up and down in the sand as it was slowly poured in. This method was found to be the best, and is the one always used at Fort Adams, in charging drill holes for sand blasting. The sand used was dry and free from dust, and from all particles which would not pass through a hole  $\frac{1}{4}$ th of an inch in diameter.

A preliminary series of experiments was tried, the results of which will not be given, as they were all subsequently repeated in a more careful and accurate manner.

In the second series, a tube of tin, fifteen inches long, having an interior diameter of  $1\frac{1}{4}$  inches, was used instead of the cast composition tube, *a*, above described, and a  $3\frac{1}{2}$  inch bolt-rope instead of the chain, *h*, *h*, *h*. The following table indicates a portion of the results obtained.

TABLE I.

No. of the Experiment.	Number of inches of sand in the tube. — Packed.	Number of inches of sand in the tube. — Unpacked.	Weight which it was necessary to place on the platform in order to force the sand from the tube.	REMARKS.
	Inches.	Inches.	Pounds.	
36		2	310	
37	2		350	
38		3	260	
39	3		360	
40	3		760	
41		4	2166	
42	4		2540	
43	4			Experiment lost.
44	4		2150	
45	5			With 2100 lbs. the piston was not moved.
46	9			With 1900 lbs. the piston was not moved.

*Observations on Table I.* The tube was of the kind called double tin, 15 inches long, and  $1\frac{1}{4}$  inches in diameter, folded at the seam, and strongly soldered. The piston was just inserted into the bottom of the tube, and the weights given in the fourth column, were those which were necessary to force it quite through the tube, with the sand before it. In the experiment No. 46, where 9 inches of packed sand were tried, after a weight of 1900 pounds had been placed on the platform, without producing any effect, an effort was made to drive the sand from the tube by forcing up the sliding board, *e*, with a lever. In this operation the tube was bent, and split at the soldering, but the sand was not forced out. It was soon ascertained that very great weights would have to be used when the depth of the sand was equal to, or greater than four times the diameter of the tube, and that the process would be tedious; it was accordingly resolved to abandon the use of dead weights, and employ the momentum of falling bodies. Previously to making these trials, a glass tube  $\frac{3}{4}$ ths. of an inch in diameter, was procured and experimented upon. It admitted six inches of sand to be forced out of it, but with 8 inches of sand well packed, it burst when a dead weight of 550 pounds was applied.

TABLE II.

No. of the experiment.	No. of inches of sand in the tube. — Packed.	Weight with which the platform was loaded. pounds.	Distance through which the platform fell with the foregoing weight.		Distance through which the piston was forced by the foregoing power.	REMARKS.
	inches.		feet.	inches		
47	5	920		10	none.	} In these experiments the rope stretched so as to permit the platform to touch the floor before producing the full effect.
48	"	1120	2	0	do.	
49	"	1320	2	"	do.	
50	"	1320	3	"	thro'the tube	} Trial defective. The rope was broken, trial defective
51	6	1320	3	"	none.	
52	"	1630	3	"	none.	
53	"	1630	3	5	thro'the tube	} The tube was split.
54	7	1630	3	0	none.	
55	"	1630	3	"	$\frac{1}{4}$ of an inch.	
56	"	2030	3	"	$\frac{1}{2}$ of an inch.	} The apparatus was broken, and the tube split. Apparatus broken.
57	"	1630	3	5	none.	
58	"	1630	3	4	$\frac{1}{2}$ of an inch.	
59	"	1930	2	6	$\frac{1}{4}$ of an inch.	} Broke one of the beams supporting the pulleys, <i>f</i> , <i>f</i> , and parted a $3\frac{1}{2}$ inch bolt rope.
60	"	2030	3	0	$\frac{1}{8}$ of an inch.	
61	"	2030	3	4	$\frac{1}{4}$ of an inch.	
62	"	2030	4	0		} Split the tube and forced out the sand in consequence. Parted a $3\frac{1}{2}$ inch white hemp rope.
63	"	2030	4	0	$\frac{1}{2}$ an inch	

*Observations on Table II.* The tube and rope were the same as described in observations on table I. The experiment No. 61, the top of the sand was made even with the top of the tube before the experiment was begun, by pushing up the piston until only so much space was left above it, as it was intended the sand should occupy. This rule was observed in all the subsequent experiments. This table shows that it required a weight of 1320 pounds, falling 3 feet, to force 5 inches of dry sand out of a tube  $1\frac{1}{4}$  inches in diameter, and 1630 pounds, falling 3 feet 5 inches, to force out 6 inches of sand. Experiments, 60, 61, 62, and 63, showed that the apparatus in its then state could not sustain the force necessary to expel 7 inches of sand, and accordingly these experiments were suspended until a cast brass tube could be procured, and an iron chain be fitted instead of the rope. Other measures were also adopted for strengthening the apparatus. While these arrangements were making, a series of experiments were tried with a conical plug above the piston, as in the annexed sketch. The height of the cone was 3 inches, and its base equal to the area of the top of the piston. The details of these experiments it is deemed unnecessary to give. Their general result was, that within the limits tried, greater resistances were obtained when the cone was used than when it was omitted.



TABLE III.

No. of the experiment.	No. of inches of sand in the tube. Packed.	No. of inches of sand in the tube. Unpacked.	Weight with which the platform was loaded.	Space through which the loaded platform was allowed to fall.	Distance through which the piston was forced by the foregoing power.	REMARKS.
87	7		1375	3	10	$\frac{1}{8}$ of an inch
88	7		1670	3	11	$\frac{1}{4}$ of an inch
89	7		1880	3	10	$\frac{1}{4}$ of an inch
90	7		2030	3		$\frac{1}{4}$ of an inch
91	7		2030	3	6	$\frac{1}{2}$ of an inch
92	7		2256	3	11	Piston forced through the tube.
93	8		2286	3	9	$\frac{1}{4}$ of an inch
94	"		2490	3		$\frac{1}{4}$ of an inch
95	"		2490	3		1-16 "
96	"		2490	3	9	$\frac{1}{4}$ of an inch
97	"		2644	3		$\frac{1}{8}$ of an inch
98	"		2644	3		none
104	7		361	3	8	Piston forced through.
105	8		361	3	3	$2\frac{3}{8}$ inches.
106	9		615	3	10	Pn. forced through
107	10		615	3	9	none
108	10		870	3	10	Pn. forced through
109	11		870	3	8	$\frac{5}{8}$ of an inch
110	11		1122	3	3	1 inch.
111	11		1375	3	4	2 inches.
113	11		1630	3	10	Pn. forced through.
115	12		1880	3	3	$\frac{1}{8}$ of an inch
118	12		2136	2	3	$\frac{1}{2}$ of an inch
120	12		2136	3	3	$\frac{1}{2}$ of an inch
121	12		2136	3		$\frac{3}{4}$ of an inch
122	12		2136	3	6	Pn. forced through
124	13		2136	3	9	$1\frac{1}{4}$ inches.

Broke a beam over head; and on taking up the floor for the purpose of putting up new props, it was found that three of the floor joists were ruined by the severity of the previous shocks. An iron axle-tree,  $1\frac{1}{2}$  inches in diameter, of one of the pillars, *f*, over head, was broken off.

Broke the axle of one of the pulleys over head. The beams supporting these pulleys were brought nearer together, and iron trunnion plates were placed under each axle to prevent its being forced into the wood.

Broke the rope *k, k*, connecting the chain with the sliding board, *e*, under the piston. A chain was substituted in the place of this rope, and the apparatus thus made to conform in all respects, with the description which has been given of it.

In this and all other cases where the piston was forced through the tube, a quantity of fine dust, apparently arising from the pulverization of a part of the sand, collected on the sides of the tube and at the top of the piston.

Broke a large iron hook at the tube end of the large chain.

Broke the large chain in four places.

Broke one of the hooks connecting the chain, *k, k*, with the sliding piece, *e*.

Broke the large chain. The apparatus could not, without considerable trouble and expense, be made to sustain the force necessary to expel 8 inches of packed sand, and the further pursuit of this inquiry was therefore abandoned.

The interior diameter of the tube was now increased to 1 7-16 in inches, with which all the remaining experiments were made.

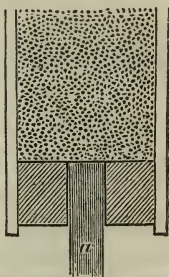
Broke the chain.

Broke the chain.

Broke the chain. This chain being much strained & worn by previous shocks a new one was procured.

Broke the chain.

*Observations on Table III.* The tube was of brass, cast about one-fourth of an inch thick, the interior diameter being one and one-fourth inches as far as experiment No. 111, after which it was increased to one and seven-sixteenth inches. A chain, capable of supporting nine tons, was substituted for the rope, *h, h, h.*, and after experiment No. 90, a strong chain was employed in lieu of the rope, *k, k.* The apparatus was strengthened in a variety of ways to enable it to resist the great shocks it was subjected to. It appears from this table, that to expel seven inches of dry packed sand from a tube one and one-fourth inches in diameter, it was necessary to employ a weight of 2286 pounds falling through a space of three feet eleven inches. A weight of 2644 pounds falling three feet, was insufficient to force from the same tube eight inches of sand. Sand poured loosely into the tube, without being packed, offered much less resistance. Seven inches of loose sand was expelled by a weight of 361 pounds falling three feet eight inches; nine inches by a weight of 615 pounds, falling three feet nine inches; and ten inches by a weight of 870 pounds falling three feet ten inches. Eleven inches in a tube of one and seven-sixteenth inches bore, was expelled by 1630 pounds, falling three feet ten inches; twelve inches, by 2136 pounds, falling three feet six inches; and 2136 pounds, falling three feet nine inches, did not drive out thirteen inches of loose sand. The strength of the apparatus did not admit of carrying these trials further in this way, and it was resolved to use gun-powder; but in the meantime to determine the resistance which would be offered by the sand to the entrance of iron rods of much less diameter than the bore of the tube, the following experiments were made. Rods of one-fourth, one-half, and three-fourths of an inch diameter were used. The tube being one and seven-sixteenths inches in diameter, a wooden piston having a hole in its centre, just large enough to admit the rod *a*, in the manner indicated by the annexed sketch, was placed in it, and the rod being entered into the piston, the sand was placed above it as usual. With this apparatus, the experiments contained in table IV. were, among others, tried.



*Observations on Table IV.* The resistance opposed by the sand to the entrance of a rod of smaller diameter than the tube, was very great, and increased with the size of the rod. A weight of 2033 pounds was required to force a  $\frac{1}{4}$  inch rod through 8 inches of sand. With 12 inches of sand, a weight of 3150 pounds was required to force the same rod, sharpened,  $2\frac{1}{2}$  inches into the tube. Sharpening the  $\frac{1}{4}$  inch rod, seemed rather to increase than to diminish the resistance. A half inch rod was forced through 8 inches of sand, by 870 pounds falling 4 feet. With 13 inches of sand, a  $\frac{1}{2}$  inch rod was forced only  $1\frac{3}{4}$  inches, by a weight of 1880 pounds falling 3 feet 6 inches. A rod  $\frac{3}{4}$  of an inch in diameter, was forced through 8 inches of sand by 1120 pounds, falling 3 feet 10 inches; and the same rod was forced through 13 inches of sand by 2136 pounds, falling 3 feet 3 inches. In all cases the sand immediately before and around the rods, was crushed to a fine powder.

#### *Trials with Gun Powder.*

166. A musket barrel, of three-fourths of an inch bore, was charged with two inches of powder and thirteen inches of packed sand, there being

neither wad nor plug between the sand and the powder. On firing, the barrel was burst, but the sand was not driven out.

TABLE IV.

No. of the experiment.	No. of inches of sand. Packed.	Dead weight applied.	Falling weight.	Distance through which the loaded platform was allowed to fall.	Distance which the iron rod was forced into the sand, by the foregoing power.	REMARKS.	
	in.	lbs.	lbs.	feet. in.	inches.		
Iron rod $\frac{1}{4}$ of an inch in diameter.							
133	8	615			$\frac{1}{4}$ of an inch.		
134	"	1150			1 inch.		
135	"	1630			1 $\frac{1}{2}$ "		
136	"	2033			thro' the sand.		
137	12	615			3-16 of an in.		
138	"	1150			$\frac{1}{2}$ "		
139	"	1630			1 inch.		
140	"	2136			1 $\frac{1}{2}$ inches.		
141	"	2480			?	Rod bent and broken.	
142	"	615			3-16 of an in.	In these trials the end of the rod was sharpened.	
144	"	1630			7-8ths. "		
146	"	2390			1 $\frac{3}{4}$ inches.		
148	"	3000			2 $\frac{1}{4}$ "		
149	"	3150			2 $\frac{1}{2}$ "		
150	8		360	3	4	2 "	
151	"		615	3	4	thro' the sand.	
Rod $\frac{1}{2}$ an inch in diameter.							
152	8		360	3	6	1 $\frac{1}{2}$ inches.	
153	"		490	4		1 $\frac{3}{4}$ inches.	
154	"		615	4		1 $\frac{1}{4}$ inches.	In this and every other instance a mass of finely pulverized sand was found at the head of the rod.
155	"		870	4		thro' the sand	The sand around the rod was pulver- ized to a fine powder.
157	13		1120	3	3	1 7-8 inches.	The rod was bent below the tube.
158	"		1375	3	3	$\frac{1}{2}$ an inch.	
159	"		1880	3	6	1 $\frac{3}{4}$ inches.	Bent the rod double in two places be- low the tube.
Rod $\frac{3}{4}$ of an inch in diameter.							
160	8		870	3	10	$\frac{3}{4}$ of an inch.	
161	"		1120	3	10	thro' the tube	The sand around the rod crushed to a fine powder.
162	13		1120	3	9	7-8 of an inch.	The pulverized sand at the head of the rod as usual.
163	"		1375	3	6	1 inch.	The chain was broken.
164	"		1880	3	6	1 $\frac{1}{4}$ inches.	
165	"		2136	3	3	thro' the sand	

167 & 168. A brass blunderbuss barrel of three-fourths of an inch bore, was charged with one inch of powder and ten inches of packed sand, a

wooden plug being placed between the powder and sand. On firing, the plug was split, and all the sand driven out, but the pieces of the plug remained in the barrel, which was apparently uninjured. The same barrel burst with one inch of powder and ten inches of packed sand, with a conical wooden plug between the sand and the powder.

169. A pistol barrel of nine-sixteenths of an inch bore, burst with one inch of powder and eight inches of packed sand, without wad or plug.

170. An old musket barrel of three-fourths of an inch bore, was loaded with three-fourths of an inch of powder and five inches of packed sand, without wad or plug. On firing, the barrel was burst, but the sand was not driven out.

172. A piece of musket barrel, taken from near the muzzle, and open at both ends, was charged at one end, with five and a half inches of brick dust, hard rammed, and at the other, with five and a half inches of sand, well packed, with one inch of powder between them, a priming hole being bored to communicate the fire. The explosion of the powder burst the barrel, but neither the sand nor the brick dust was driven out.

177 to 184. A pistol barrel made of twisted iron, and of great strength, the bore being eleven-sixteenths of an inch, was fired with three-fourths of an inch of powder, and the following loads of sand, each one, with, and without, a wad, viz: three inches, four inches, five inches, and six inches. In all these trials the sand was driven out without causing the barrel to burst.

185. The same pistol barrel was loaded with one inch of powder, and eight and one-fourth inches of sand, with a conical plug between the sand and the powder. On firing, the sand was forced out.

186. The same barrel was charged with one inch of powder and eight and one-fourth inches of sand, without wad or plug. On firing, the sand was driven out, and the barrel was burst.

In order, if possible, to determine a limit to the resistance opposed by sand, it was resolved to make use of a twenty-four pound cannon. It was thought not improbable, that by the use of clean dry sand, which is generally obtained in the vicinity of the sea coast batteries, a ready method would be discovered of effectually destroying heavy guns, an object which is occasionally of great importance. Application was therefore made to the ordnance department for permission to experiment with an old pattern twenty-four pounder, laying at Fort Adams, which permission was very liberally and readily granted. The length of the bore of this piece was about nine feet, and the diameter of the bore  $5\frac{82}{100}$  inches. It was first fired in a horizontal position, with eight pounds of powder and one foot of sand, afterwards with the same quantity of powder and two feet of sand, again with the same quantity of powder and three feet of sand, and so on, the depth of the sand constantly increasing by one foot, until the bore was full. The gun was then placed in a vertical position, and loaded with the same quantity of powder, and filled up to the muzzle with sand, well packed, without wad or plug. It was afterwards charged in a similar manner, a cone of wood being interposed between the powder and the sand. In these two cases the fire was communicated to the charge by means of a priming tube, passing down through the sand from the muzzle of the gun. Afterwards the gun was charged in the same manner, and fired by means of the vent. A better quality of powder was then used, and the quantity was increased to sixteen pounds. The gun was several times fired with this charge, the bore being filled up to the muzzle with sand well packed. In every in-

stance the sand was forced out without apparent injury to the gun. It appeared, therefore, that the resistance of the sand, though very great, was not sufficient to burst a twenty-four pound cannon.

The most probable explanation of the foregoing phenomena, appears to be, that whenever direct pressure is applied, the angular and irregular shaped fragments composing the sand, immediately form themselves into a natural arch, supported against the sides of the tube. The annexed sketch indicates the manner in which this may take place. In every instance where the sand was violently forced from the tube, the sides of it were found to be lined with a quantity of fine dust, and a mass of pulverized sand was generally found at the head of the piston A. The inside of the tube was abraded or scratched, particularly at that part, a short distance above the piston, against which the *arch*, or more strictly, the *inverted dome* of sand, may be supposed to have abutted. The dust found on the sides of the tube was always of a blueish colour, which was attributed to the intermixture of a small portion of metallic oxide derived from the brass. Some experiments which were made went to show that it was very important that the sand should be perfectly dry. The injurious effect of moisture may be explained by supposing that it impedes the free motion of the particles among themselves, and prevents their promptly assuming the arch form; it cements the sand into a mass, which is expelled from the tube as a solid body would be. In the case of the twenty-four pounder, it appears that the force necessary to burst the gun, was greater than that required to reduce sand to an impalpable powder, that is, to crush and destroy the materials of which the arch of sand was composed. It is probable that coarse emery, from its extreme hardness, would oppose a resistance sufficient to burst a cannon, but an opportunity has not offered to make the trial.



The experience at Fort Adams, proves that the resistance offered by sand is quite sufficient for blasting rocks, and the advantages attending its use, are, that it is much less troublesome than the usual mode, and that it is perfectly safe. To ensure success, the space left above the powder should have a length of ten or twelve times as great as the diameter of the hole. To communicate fire to the powder, a slip of paper is rolled into a tube about three-sixteenths of an inch in diameter. This priming tube is secured by being tied round in two places with thread, and one end is made a little larger than the other, so that any required length may be obtained by joining several together. The charge of powder being in its place, the priming tube is inserted and filled, it is then pressed against one side of the hole, and the sand is slowly poured in. A slender stick of hard-wood is rapidly worked up and down in the sand as it falls to the bottom, and thus every part becomes well packed. By this mode of operating there is, of course, no danger of communicating fire to the powder in the act of loading, an accident very liable to happen in blasting in the common way. The safest and most convenient method of firing the blast is by means of a small slip of paper which has been dipped in a solution of salt-petre, and dried.

It was intended to make examinations on other points connected with the phenomena observed by M. Burnand, but the requisite leisure has not been at command. The subject merits further investigation with a view to making useful practical applications of some of the remarkable properties which sand is found to possess.

*On the manufacture of Military Projectiles, translated from the French of F. I. Chumann, Chief d'escadron d'artillerie, &c. &c. By ALFRED MORDECAI, Captain United States Ordnance Department.*

(CONTINUED FROM p. 17)

### *Of the Lathe.*

The lathe for turning cores consists generally of four stakes driven into the ground, and surmounted by a kind of rectangular frame of wood; the two pieces of this frame which stand in a direction perpendicular to the spindle of the core, may be called the transoms; their distance apart varies with the diameter of the core. The transom which is on the right hand of the workman, as he faces the lathe, has a copper gudgeon box to receive that part of the spindle which is next to the smaller base of the swell: this base should rest against the gudgeon when the spindle is on the lathe. The other transom is furnished with a square piece of iron, which forms the nut of a screw terminating in a point, and intended to support the end of the shaft, in which there is a small conical hole to receive the end of the screw. A crank, with a rectangular hole in it, is adjusted to the upper part of the spindle which it serves to turn. A weight suspended to an iron hook, prevents the spindle from leaving the gudgeon box.

### *Of the preparation of Sand Cores.*

Cores of sand are formed on a nucleus of clay. The spindle is first placed in the lathe, turning the screw until the small base of the swell touches the gudgeon, so that the swell is between the two transoms. After having put in place the double hook to which the weight is suspended, the workman rolls a rope of straw around the spindle, making three or four turns. This rope is kept in its place by wooden pins, which are burnt during the process of drying and casting. He then applies several layers of clay, until the nucleus has the dimensions of the pattern. Before the nucleus is quite dry, several holes are made in it, in order that the sand may adhere more readily.

The model of the core is a copper box, divided into two parts by a plane through the centre, perpendicular to the axis of the eye. Its interior form and dimensions are those of the core, allowing a few points in excess for shrinking, if the projectile is of a large caliber. This shrinking cannot exceed three points in twelve inch shells; it is almost insensible in small ones.

One of the hemispheres of the box is terminated by a plane, and consequently remains open, when the shell is to have a culot; in the contrary case when the shell is to be concentric, that hemisphere is pierced at the pole, with a hole through which the sand is introduced, and which is afterwards closed by a cap. The other hemisphere, that which is first filled, has a hole of the diameter of the core of the eye, and is firmly fixed in a piece of wood which is let into a tripod stand.

The two parts of the box are connected by a groove, and fastened together by a ring which embraces the upper hemisphere, and which is confined by two hooks, acting at the extremities of a diameter.

To fill the lower hemisphere for the purpose of moulding the core, first place the spindle furnished with the nucleus, and with the core of the eye, which should be made of clay with great accuracy, calibered, and finished dry *on the lathe*. The swell of the spindle should rest against a small plate of iron fixed to the stand, so that the distance from the swell to the

core shall be constant, and equal to the distance from the traverse to the mould of the shell, added to the thickness of the metal. That thickness, measured at the eye of the shell, is then subject to no variation, if the traverses, the flasks, and the spindles, are perfectly alike, and if the latter correspond with the spindles of the models. In ramming the sand into the first hemisphere, the workmen should be careful to withdraw the spindle a little, and to be certain that it rests against the plate of iron above mentioned; for the ramming of the sand below the nucleus of the core tends to raise the spindle.

The rammers used are curved, and may be made either of iron or wood. When the box is perfectly full, the sand is leveled with a rule, then smoothed and compressed with a trowel, if the shell is to have a culot: if not, it is only necessary to fill the box by ramming closely, and to stop the hole with sand, which is afterwards compressed by applying the cap. To withdraw the core from the mould, the upper hemisphere of the box is taken off, whilst the lower remains fixed in the wood. The end of the spindle is inserted in a hole made in the stand; the core being then perfectly free may be trimmed at the seam, or circle of junction, which always leaves a kind of bur that it is necessary to remove.

The core when trimmed, is dipped into clayey water, made more glutinous by the addition of horse dung: very fine powdered coal is also added to the water: this coat of coal dust prevents the sand from adhering to the metal. If the mixture is not sufficiently adhesive, the powdered coal does not stick to the core, but becomes detached and floats on the metal, which causes large wrinkles about the eye of the shell. After this, the core is thoroughly dried; the least quantity of water remaining in it would either make the casting fail, or would produce great defects about the eye. It is always better to bake the core too much than too little, and failures are generally attributable to the neglect of this precaution. The purer the sand the more easily it is dried; but it is necessary to use sand containing a little clay, in order that the core may have the requisite consistence.

Common salt has the property of causing sand to harden very readily; a solution of salt, enables us, therefore, to use very loose sand, which is a great advantage; but cores made in this manner must be used immediately, for salt, being very hygrometric, would, in twenty-four hours, absorb water enough to spoil the casting. This method therefore can be used only under particular circumstances. Generally speaking, the cores should be exposed to a red heat, unless salt be used: they may be dried on the trunnel head without expense.

#### *Of the preparation of Cores of Clay.*

The nucleus is made in the manner before described, taking care to insert straw in the groove of the spindle when it is solid. It is dried at the doors of the furnace, avoiding immediate exposure to a red heat, and thus burning the straw. When the nucleus is dried, it is fixed better on the spindle, and prevented from slipping towards the swell, by means of a bit of slate introduced into one of the holes made in the spindle. After another layer of clay has been added to the nucleus, a second piece of slate is inserted in the hole at the end of the spindle. The core is then again dried, replaced on the lathe, and thus the operation is continued until it has received the requisite dimensions, calculated according to the dimensions of the projectile, and the contraction of the clay by a red heat. The number of layers given to each core, and consequently, the number of times it is dried,

varies with the caliber of the shell. At Hayange, five successive layers were formerly added to the nucleus for twelve inch shells, and two only for six inch or eight inch howitzes. At the furnaces of the Ardennes, the cores even for twelve inch shells were made in three layers. The process must necessarily differ according to the quality of the clay, its power of retaining moisture, and the degree of heat requisite for drying it. Although the dimensions of the last coat of clay given to all the cores, are regulated by the same pattern, calculated on the dimensions of the cavity and the contraction of the clay, the finished cores have never the same dimensions; they have not only lost their sphericity, but some have become too large, others too small. They therefore undergo another operation, called *dressing*. They are first examined by the aid of three instruments, the ring gauge, the half circle, which is a section of the core, and the caliber plate for the eye. The parts where they are too large are then scraped with a knife, and clay is added where the dimensions are too small. This operation is performed by hand, and there is consequently no certainty of accuracy. It is essential that the last coat of clay given on the lathe should be very thin, in order that the defects of form, which evidently result from the great contraction of clay by heat, may take place in the last layer but one, which ought to be so thick that the core before being dried, should have, at least, the dimensions it is to have when finished and dried. Instead of performing the operation of dressing by hand, it might be done on the lathe, by substituting for the pattern board a piece of iron, or tempered steel, and scouring the core with a paste of clay mixed with sand. The core of the eye should be turned when dry, and reduced with a chisel to its exact dimensions. This remark applies equally to cores of sand, and to those of clay. When the core has been dressed, it is blackened with coal powder, and again dried.

If the inspector, in verifying the cores with the gauge intended for that purpose, finds any that are too small, he should break them at once: because cores after having been dried and blackened cannot be increased in size. The workmen, who often judge erroneously of their own interest, and who moreover pay little regard to that of others, would secretly use these cores without alteration, with the hope, doubtless unfounded, that the defect of a projectile of which the metal should be too thick, would not be perceived in the inspections.

It is not so in the case of cores which are too large; they may be corrected by scraping and blackening them a second time. Generally speaking, the cores are blackened after having been dressed, and they are again dried.

The mere description of these different processes, shows that whatever degree of care is bestowed on cores made of clay, it is impossible, in making a great number, to have them exactly alike. It is therefore much better to make them of sand.

#### *Of the preparation of the Mould.*

To prepare the mould the workman places the upper hemisphere of the model on a board furnished with two battens, which enables him to seize it more easily underneath. He then inserts the spindle into the hole of the traverse, and places the *drag* on the moulding board. By turning the flask he makes sure that it touches the board, and that it rests against the swell of the spindle, which is an essential point. If the flask did not touch the board the projectile would be flattened, the polar diameter becoming too small: if on the other hand, the flask rested on the board, and the traverse did

not touch the swell of the spindle, the metal of the projectile would be too thin near the eye. These defects are but too often met with, because the flasks are warped out of shape. After the flasks have been properly placed, the gate is fixed; that is to say, if the shell is to be cast with the eye downwards; if the reverse, the vertical part of the gate would be placed in the sand of the cope. The workman supports with one hand the foot of the gate, which he adjusts on one side against the model, and on the other against the vertical part of the gate, around which he immediately packs a little sand. As his assistant fills the flask the moulder compresses the sand, either with his hand, in the angles, or in the middle, with a wooden paddle. If he is forming the mould of a large shell, he places the ears, and when the sand has reached a proper height, he presses the sand against them with his thumb, and supports the rings until they are fixed. As soon as the flask is entirely filled and the sand has been well rammed, the workman removes the superfluous sand with a rule, forms a funnel about the upper part of the gate, and with a needle pierces the sand in several places, to make vents, particularly above the ears. He then turns the flask on another board, furnished also with battens, and called the *false bottom*; he removes the moulding board, places the other hemisphere of the model in its groove, and lays the second part of the flask on the first, by making the dowels enter their corresponding holes; he sprinkles powdered charcoal on the model and on the sand, to prevent the fresh sand from adhering to the first, and fills the flask as he had before done, taking care to compress the sand a little more firmly if the projectile is to be cast with the eye uppermost. To remove the model the workman inserts a small bar of iron into the mortise of the spindle, slips under this bar a piece of wood, such as a paddle for instance, which resting on the sides of the flask, acts as a wedge under the bar, so that the model pressed against the sand, may not be displaced when the flask is removed. Turning the flask then on its side, he strikes a few blows with his paddle on the model, and detaches it, after having withdrawn the iron bar which confined it. He then places the model on a level board, fills the hole left by the spindle, and smooths the mould with the *mushroom* and the *sage leaf*; two small iron tools, which are used only for this purpose, and the forms of which are sufficiently indicated by their names.

The moulder uses the same method to remove the first hemisphere of the model: he withdraws the ears; lays the mould on a tripod stand without a top; places the core, measuring with a T the distance at which it should be from the equatorial diameter of the shell, and fixes it firmly either by inserting a key into the mortise of the spindle, or by driving nails between the stem of the spindle and the sides of the hole in the traverse. Having done this, he again joins the flasks and presses them closely together, either with key bolts, if the flasks are of cast iron, or with small hooks attached to the wooden flasks.

It is evident that if the two flasks were not pressed together sufficiently, the projectile would have a thick seam, which would be injurious to it, and it might also become too large in a polar direction. The latter cause added to the compression of the sand by the expansion and weight of the metal, often produces elongated projectiles. On the other hand they would be flattened, if in moulding, the flask rested only on the swell of the spindle, and left an interval between it and the moulding board. The flattening of a shell may also be occasioned by using too much sand to stop the hole of

the false spindle; it is therefore better to suppress the false spindle of the model for calibers of six or eight inches, as the flasks when filled with sand are still manageable.

To remove the model in that case, the two flasks are inverted together, a nail driven between the traverse and the spindle, and the hemisphere containing the eye is first removed.

*Of casting and finishing hollow Projectiles.*

The liquid metal should form a continuous stream, small at first, in order not to injure the mould. If the projectile is so large that the mould cannot be filled by a single ladle full, they should follow each other without interruption, and the contents of one should be poured into another, instead of being introduced immediately into the mould. The bottom of the ladle is of hammered iron, which the moulder covers with clay, with which he also lines the edge. He renews the lining at each casting, and dries it on the hot slag.

An assistant holding in one hand a piece of wood, and in the other a piercer, cleans the surface of the metal, and prevents the slag from running into the mould. It is necessary that the gases which are developed in the core should escape freely; if they do not immediately appear, either at the vents, or principally at the eye, where they ought to burn with a blueish flame, the assistant inserts his pierce in the groove of the spindle, and presents a piece of lighted wood, to set fire to the gases, and facilitate their escape. If the core has been badly dried, or if the sand of the mould is too wet, these gases are at first found in so great a quantity, that being unable to escape entirely, they prevent the metal from entering the mould; it then rises in the gate, and the casting fails. That accident may also happen if the metal is poured in too rapidly at first; without exactly rising, it sometimes receives from the same causes, a motion in the interior of the mould; in that case, little scales are formed on the projectile, which adhere but slightly to the mass of the metal, and which are easily detached with a hammer, particularly about the eye and the ears; this injures the shell and may become a cause of rejection.

A quarter of an hour after the casting, when the metal, though hard, is still quite hot, the upper flask is removed, and the gate detached with a hammer; the spindle of the core is then inserted in a winch and withdrawn. To draw out the spindles of sand cores, a greater effort is required than for those of clay, because the straw which envelopes them is more burnt in the latter, on account of the greater heat to which they are exposed in drying.

The bur which is formed about the eye is next removed with a rasp. This operation requires particular care, to prevent breaking the eye, which would almost always happen if it were rasped at too low a temperature, or if the bur were too thick; this occurs when the swell of the spindle of the core does not exactly fill the cavity formed by that of the model, the greater base of which is a little smaller than the orifice of the eye. The requisite dimensions are given to the eye by means of a six sided reamer, and they are verified by a gauge. The eyes, which from the inattention of the workman, are not sufficiently large, are afterwards reamed out when cold: a countersink in the form of a very obtuse truncated cone, serves to remove the sharp edge of the eye.

It is advisable to remove the projectiles out of the foundry while they are yet hot, in order to sprinkle water on them, and facilitate the removal

of the sand. But this sprinkling of water increases the contraction perceptibly: attention should therefore be paid to it, in determining the dimensions of the model.

When the projectile has become cold, it is handed over to the finisher who places it on a bench composed of two pieces that do not touch each other, between which it is secured by means of wedges. He breaks the core with a hook and a kind of chisel, turns the shell several times, to empty it entirely, and by means of a hammer and a rasp, removes the sand which still adheres to the surface. This sand adheres more strongly in proportion as it contains more clay; it is often necessary to chip the metal in order to remove the sand entirely. This facilitates oxidation, and injures the appearance as well as the quality of the projectile. We have indicated the method of preventing this defect, by mixing the sand with the dust of mineral coal, coke, or charcoal, and by wetting the projectiles immediately after they are cast. The seam and any roughness of the surface are removed by the chisel.

Projectiles which are of irregular dimensions should be always rejected, unless they can be ground to a proper form. Permission is sometimes given to dress with the chisel a certain number of these defective projectiles, which produces very bad results; especially if it be necessary to remove the metal on a large portion of the surface of the shell. Those which are carefully ground have a very handsome appearance; but, in common with those which are dressed with the chisel, they have the great fault of being liable to rust.

#### *Of the manufacture of Shot.*

Shot were formerly cast in iron moulds, called *shells*; they were afterwards hammered. It is about ten years since the casting of them in sand commenced: a great improvement, which however, is not yet definitively adopted.

The iron moulds consist of two equal parts, which are let into each other: each half is furnished with two handles. The gate, which is very wide at the mouth, is placed at the highest point; the plane of junction or rather the joint, is vertical at Hayange, and horizontal at some other foundries, as for instance at those of Niederbrunn.

The models for these moulds are made of copper, encased in wood to prevent their being altered by use. The inner surface of the copper serves to make a core of sand which forms the cavity of one half of the mould. As the exterior surface of the moulds may be left rough and uneven, they are cast uncovered; that is, the model is merely impressed in the sand, and removed without covering the hollow thus made, which is then filled with the liquid metal. In this way large objects, of which the under surface only is required to be exact, are generally cast. In this way it is evident that the joint of the mould is horizontal when it is cast. The interior of these moulds is not spherical. The vertical radius is smaller than the horizontal, which is that of the joint. The following differences are allowed,  $3\frac{1}{2}$ , 3,  $2\frac{2}{3}$ ,  $2\frac{1}{3}$ , 2,  $1\frac{2}{3}$  points, for the calibers of 24, 16, 12, 8, 6, 4, respectively. These data have been furnished by experience.

These moulds produce, therefore, spheroids flattened in the horizontal direction, perpendicular to the plane of junction. The shot obtained from them are consequently a little reinforced at the seam or bur occasioned by the joint, and it is necessary that they should be so; because that part re-

ceives under the hammer, a great number of blows which tends consequently to diminish this great circle and to increase those perpendicular to it.

In many founderies it is moreover customary to remove the bur with the rasp, when the shot have been heated for hammering; that operation, which is very bad, as we shall see, also requires that the projectiles should be larger at the seam when they leave the mould.

In casting shot, the two parts of the mould are joined together, after having been washed with muddy water. They are placed on a piece of cast iron furnished at the two extremities with two arms, which serve to hold the moulds, and by means of which they can be wedged together. It is to be observed that the gate should be vertical, and the handles turned outwards. They are connected in sets consisting generally of about twenty moulds.

The metal is dipped out from the crucible of the furnace with ladles, and is poured into the moulds in a regular stream, care being taken to skim it constantly.

### *Of casting Shot in Sand.*

The moulds for shot are made of sand in a manner similar to those for howitzes. When this method of fabrication was first ordered in the department of the Moselle, in 1824, it was directed to roll the shot in an iron cylinder before hammering them. We had already made in this manner, in 1821, about fifty shot, which we showed to Lieut. Gen. Tyrlet, who thinking them very good, took several of them to show the committee of artillery.

Our experiments were varied in different ways. We used both the metal which furnishes brittle iron, and which is generally used for making projectiles, and the metal of tough iron, with which carriage flasks were then made; the shot were either rolled, or hammered, or else rolled first and then hammered.

The following are the conclusions which we have derived from these experiments:

1st. Shot first rolled and then hammered, are very superior to those which have undergone only one of these operations.

2nd. Hammering cannot be advantageously replaced by rolling; if we do not wish to adopt both of these operations, it is infinitely better to retain the former.

3rd. The ore of tough iron gives shot of a more even surface than the ore of brittle iron.

4th. The small cavities which often appear at the upper pole of a shot, occur as frequently with one of these kinds of ores as with the other.

It is to be remarked that the small cavities in question, and of which we have already spoken, are not found in all kinds of cast iron. There are founderies in which this defect is scarcely known; shot made of white metal are always free from them; but they have others still greater. We shall return to this subject in speaking of rolling, hammering, and inspecting shot.

### *Of Models for Shot.*

The models of shot resemble those of hollow projectiles; but they have only one spindle, which is pierced at the upper end with a mortice to receive a small ruler, and is of use only for removing the model. If shot are to be only rolled, or to be hammered after rolling, the models should be

spherical, except that of the twenty-four pounder shot, because the weight of this projectile may compress the sand, and cause it to give way unless it is very firmly rammed.

The models of shot which are to be hammered without first rolling them, should be made a little full at the plane of juncture. For this purpose they are flattened in the contrary direction; if of a heavy caliber this flattening should commence at a considerable distance from the poles. The reasons for adopting this form have been already given.

We have often remarked that all projectiles undergo a slight depression along the seam, both above and below; this fact is probably connected with the phenomenon of the contraction of a fluid vein escaping from an orifice. It would follow that all the models ought to be a little full at the plane of junction; but it is not so, because the workman striking gently on the models to disengage them from the sand, cannot avoid enlarging the mould at the equatorial diameter: the small increase of diameter which results from this cause, compensates for the depression alluded to.

The form of the moulds in different cases, should therefore be governed by the reasons heretofore stated.

In turning the models they are at first made spherical; if necessary, they are afterwards flattened, according to a particular pattern cut out of sheet iron, which serves as a guide. These models should rather be made too large than too small, as we have before remarked, because they can be easily reduced, but cannot be enlarged. But with the same model and the same metal we may obtain larger or smaller shot, according to the manner of ramming the sand.

The foot of the gate ought to be thin and broad; the angles at the end which touches the model, should be a little chamfered, in order that the gate may be more easily detached.

#### *Of Moulding and Casting Shot.*

Several shot may be cast at one time in one flask, by arranging the moulds in two rows, between which is placed a principal gutter, running through the whole length, from which the metal passes into the moulds by small channels terminating at each mould.

For this purpose there are first placed on the moulding board, the model hemispheres without spindles, and the gates according to the arrangement they are to have. The moulder fills the flask, packing the sand as it is put in, smooths it, opens the mouth of the gate, makes five or six vents with a piercer two lines thick, and turns the flask on a *false bottom*. He afterwards puts in their places the other hemispheres furnished with spindles, sprinkles powdered charcoal on the model and on the sand to prevent the adhesion of the fresh sand, places the second part of the flask, taking care to fasten the hooks or bolts, and fills it, compressing the sand more closely than in the first flask, especially if the shot are of a large calibre.

To remove the model, the workman introduces small rulers in the mortises of the spindles, takes off the flask which he has last filled, lays it on its side, proceeds as has been directed for the shells, and joins the two flasks again, fastening the hooks or key bolts which secure them together: the mould is then finished.

The metal should be poured in more slowly in proportion as it is more liquid. The size of the gate ought to vary, indeed, with the degree of fluidity of the metal; but this is not practicable.

When the metal begins to become solid, the flask should be turned upside down. It has been observed that when this is not done, a cavity or at least a slight depression, is formed at the superior pole, which is prevented by upsetting the flasks. The bubble of gas which causes it, being thus driven back towards the centre, does not occasion so great a displacement of the centre of gravity, and the shot becomes more spherical. It is very important to seize the proper moment for turning the mould, which varies from one day to another, if the metal is not the same.

It is particularly this defect observed in shot cast in sand, and seldom in those cast in iron moulds, which has caused doubts as to the preferable method. The decision has been at length made in favour of the former, on account of the greater accuracy of dimensions and form in the shot thus made, and of the smoothness of their surface. We are of opinion that if shot cast in iron moulds, which are otherwise very imperfect, have not the defect we have just mentioned, it is to be chiefly attributed to the position of the gate, which is straight and terminates at the highest point of the mould. This arrangement could not be made for shot cast in sand moulds; the gate must necessarily be placed at the plane of junction, in order that the metal may run along the inner sides of the mould, without falling suddenly on the bottom, which would not fail to injure it. But the cause of the defect being known, we immediately see a radical remedy; instead of removing it at the expense of the density of the shot, it will be sufficient to make at the upper pole of the mould a very large vent, like a gate, to place the mould carefully in a horizontal position, to increase a little, if necessary, the height of the upper flask, in order that the liquid metal may be subjected to a greater pressure, and to pour in the metal very slowly towards the last. When the shot are cold they are trimmed: this operation is often performed with a hammer, and in a very rough manner, when the shot have been cast in iron moulds: a remedy is afterwards attempted, when they are hammered, by rasping them while hot, which is very faulty. It is important that the shot should be carefully trimmed with the chisel, especially if they are to be only rolled afterwards.

(TO BE CONTINUED IN OUR NEXT.)

*Suggestions in regard to regulations for the safety of Steam Boilers.* By  
A. C. JONES, *Engineer.*

In the law proposed during the last session of our Congress, for regulating steam vessels, I find that some very essential matters are entirely unnoticed; some of these I propose to pass in review. First. Nothing is said about having an additional safety valve to the boiler. This, however, is admitted to be a necessary appendage, as it is of importance that one of the valves should be secured by fixing a box or basket over it, to prevent it being overloaded. The regulation adopted abroad, for keeping the lock-up valve from adhering to its seat, namely, to examine it at stated times, is imperfect, as I have known valves to cement to the seat in a few hours from the time of examining them. The following simple arrangement would serve to keep the lock-up valve free. Suppose the valve to be loaded with a weight placed upon it; to the top of this weight a cord, or small chain, is attached, and passing through the cover of the box, is carried over a pulley and made fast to the cord connected with the valve, under the engineer's charge, and by which he raises it. It is evident that when the engineer

raises his valve, the other will be opened simultaneously, and consequently the lock-up valve will be prevented from cementing.

In the seventh section of the law referred to, directions are given how the engine shall be managed at stopping places. The method in common use for slacking the fire is to open the furnace doors, and nearly to close the damper. If it were entirely closed, the flame would come out at the furnace door. This method is, however, very defective. I have found by experience, that steam will be generated as fast for a limited time, under these circumstances, as if the fire was in active combustion. No cold air, or very little of it, enters the fire doors, for the simple reason that there is no outlet for it, and the active heat in the fuel will, therefore, keep the steam high, even when the engine is running. I have run a large engine with anthracite coal, which being fairly ignited, I have kept the damper closed for hours, the combustion being meantime maintained, the air passing through the crevices around the damper. The reasoning supported by the fact just stated, proves conclusively, that the generation of steam will not be *quickly* checked by the common methods of damping. To effect this purpose, the arrangement of the furnace should be such that the ash pit, or pan, could be closed so effectually as to prevent air passing through the grates. The damper and fire doors being then opened, the cold air passing over the surface of the fuel, will cool the boiler in its passage. The proposed regulations have omitted to establish any rules for cleaning the boilers. These, of course, would have to vary with circumstances, but should be laid down as carefully as possible. The proposed regulations will be productive of greater safety, by making engine builders pay more attention to the construction of the boilers. If the steam chimney of the Wm. Gibbons, or of the Ohio, had had stay bolts to connect the flue with the shell in that part above the roof of the boiler and rings, shown in the annexed cuts, enclosing and riveted to the flue, no collapse of the flue would have taken place. I suggested this arrangement to a boiler maker several years since, and his answer was "that the plan was good; but as long as the old method answered, there was no necessity for incurring additional expense."

Fig. 1

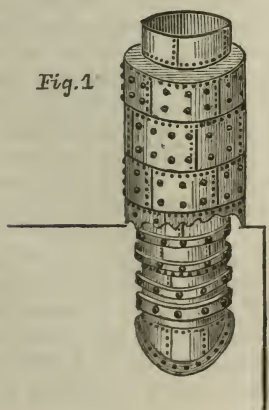


Fig. 1st, shows the steam chimney as strengthened by the stay bolts and rings.

Fig. 2.



Fig. 2nd. One of the rings, the internal projections, being in contact with the flue, with rivets passing through them.

*Further remarks, on suggestions, by Mr. Perkins, in regard to the Explosion of Steam Boilers.* By a CORRESPONDENT.

In the June number of this Journal,\* I commenced an examination of certain suggestions in regard to the explosion of steam boilers, by our countryman Mr. Perkins. The examination was made by the light of *direct experiments* by the Committee of the Franklin Institute, on the explosion of steam boilers. It was there shown that the following suggestions of Mr. Perkins are erroneous, viz: First, that the gradual increase of pressure within a steam boiler, cannot produce all the effects of the most violent explosions. Second, that the projection of water into hot and unsaturated steam, can produce highly elastic, or explosive steam.

I now propose to apply the experiments of the Committee above referred to, to test the further suggestions contained in the article under examination.

It has been seen in the preceding essay that Mr. Perkins assigns as one cause of explosion, that water gets too low in a boiler. Then according to him, the metal becoming heated forms unsaturated steam which rises, and water being thrown into it, is flashed into explosive steam.

In justice to the very direct experiments of the Committee on explosions, I ought to have inquired whether surcharged steam could exist in a boiler containing water. Whether such steam would not take up water and become, in a greater or less degree, saturated. But as the answer would have been favorable to the statement, that unsaturated steam might so exist, I passed on, taking the circumstances to be as stated by Mr. Perkins. The reader will, however, find this point fully settled in the answer to the fourth inquiry of the Committee.† A fire being made upon the top of a boiler, while the quantity of water within was kept at about 308° Fah., the steam became highly surcharged, so as to attain a temperature of 533° Fah. This surcharged steam remained above the water, which varied from three inches to .9 of an inch in depth, more than two hours, its pressure not rising above seven atmospheres; while saturated steam of the same temperature would have had a pressure of more than *sixty atmospheres*. These experiments stood a severe test, now to be described. Setting out with steam of 308½° Fah., the pressure of which is 5.2 atmospheres, if heat be applied to expand it as a gas, supposing no water to be taken up, the steam will have, by calculation upon the known rate of expansion, a pressure of 6.75 atmospheres.‡ As satisfactory a coincidence, with the pressure actually measured, and which is stated above, as could be desired.

Though this hot steam may exist in a boiler, there seems no occasion to guard against its remaining, or to look for a method to indicate its existence, since it is proved that the projection of water into it will diminish, not increase, its pressure.

I proceed next to examine the effect of water thrown upon hot metal, and it will be seen that Mr. Perkins is fully borne out, in assuming this as a source of *very great danger*; that he should, in fact, have looked entirely, to the heated metal itself, as the cause of explosion, and not to the surcharged steam which it may produce. The committee on explosions took the course, involving assuredly some personal danger, of making a di-

\*See page 369, vol. XVII.

† p. 73, vol. XVII. Jour. Frank. Inst.

‡ Ibid. p. 74.

rect experiment on this point.\* The bottom of the experimental boiler being heated to a red heat, water was injected by the forcing pump, and the pressure obtained ascertained by a gauge. In every case the pressure rose very rapidly.

"In the last experiment, the glass window at the fire end of the boiler, blew out with a quick, sharp report, as loud as that of a musket; the fragments of glass, from a hole in the centre of the plate, were projected through a window, about three feet from the boiler, and could not be found. The number for twelve atmospheres is placed opposite to this experiment, as being an approximate result. In the act of observing the gauge, the glass window burst, and the mercury at once fell: the number of inches at which the mercury had certainly risen, and above which it was, by an undetermined quantity, not however very considerable, was noted; and from this the pressure given in the table is calculated. Here explosive steam is generated by the injection of water upon red hot iron, and in a time not exceeding one or two minutes at the most, the interval between the last stroke of the pump and the explosion, not having been sufficient to note the height of the gauge; the experimenter being at the pump, which was adjacent to the gauge."

The glass window referred to, we are elsewhere told, was three-eighths of an inch thick, and its dimensions were two and a half by one and three quarter inches.

Here then, by the injection of a limited quantity of water, which it is stated was not sufficient to cool the metal to the temperature at which it would have produced steam most rapidly, a bursting pressure of eleven atmospheres was rapidly produced.

Some experiments originally made by Klapproth, and repeated by Mr. Perkins, seemed to show that water thrown upon very hot metal, was so entirely repelled by it as to generate but little steam. Indeed, this has been regarded as a stumbling block in the way of the theory, which assigns to the hot metal so important a part, in producing explosions. It was this, probably, which led Mr. Perkins to abandon the idea that heated metal is the source of danger, in favour of the hot and unsaturated steam. It was the consideration of such results, that induced Mons. Arago† to say, that in order to complete this theory, which he attributes to Marestier, it must be shown why the water in a boiler acts differently when thrown upon hot metal from the small drops in the iron spoon, in Klapproth's experiments. The committee of the Franklin Institute, have not only proved the fact to be that explosive steam may be produced by throwing water on red hot metal, but have supplied an answer to the difficulty just referred to, by an elaborate series of experiments‡ on the vaporization of different quantities of water in metallic vessels of different materials, thicknesses, states of surface, &c. and have pointed out the influence of all these circumstances on the rapidity with which water is converted into steam. The effect of pressure in modifying the results was appreciated in their first experiment.

The direct experiment before referred to, being sufficient to meet Mr. Perkins' views, I pass on for the present, intending to recur to these other experiments, for information quite as important as the fact under review.

If then the water in a steam boiler should fall below its proper level, the portion of fire surface exposed without water, could become unduly heated as in the experiments of the committee. But how are we to find the water to be thrown upon the hot metal? Mr. Perkins answers this question, by

\* Ibid, p. p. 14, 15.

† *Annuaire du bureau des Long.* 1830, p. 191.

‡ *Jour. Frank. Inst.* vol. XVII. p. p. 90, 91, &c.

supposing the safety valve to be "suddenly raised, the water will [then] be relieved from the steam pressure," and rush up, and "that part of a boiler which has been raised in temperature, giving off its heat to the water so elevated, steam is generated in an instant, &c."

Is it the fact, as here asserted, that water when relieved from pressure, does rise into foam? Again, when that foam is thrown upon the sides of the boiler, does it generate more steam than is sufficient to compensate for the loss of steam which produced the diminution of pressure and thence the foaming?

When M. Arago wrote his essay on the explosion of steam boilers, he could not decide the first of these questions; he brought general analogy to bear in favour of the probability that this foaming was produced. The experiments of the committee on explosions have supplied, completely, the desired information. They examined the question in its bearing "upon the apparatus designed to show the level of the water within the boiler," and also upon the question now before the reader.\*

"The first experiments on the effect of relieving water in ebullition from pressure were made in a glass boiler: here the fire was under the whole length of the boiler, which was a cylinder of fourteen and a quarter inches in length, and seven and a half inches in diameter. The steam within, being at a pressure of less than two atmospheres, by opening a cock at the end of the boiler, or the safety valve, also at the end, large bubbles were formed through the whole extent of the boiler.

The inquiry was prosecuted in the iron boiler already described, a distinct view of the interior being had through the glass windows placed in the heads. The greatest intensity of the fire was in front of the middle of the boiler, and extended through about one-third of its length: the part immediately near the flue, was next to this band in temperature. With this boiler experiments were made, which showed, that on making an opening in the boiler, even when the pressure did not exceed two atmospheres, a local foaming commenced at the point of escape, followed soon by a general foaming throughout the boiler, the more violent in proportion as the opening was increased. This small boiler was completely filled with foam by opening the safety valve, (nearly two-tenths of an inch in area) which was placed on the middle of the top, and the water violently discharged through the opening of the valve. The area of the valve bears to the horizontal section of the boiler, at the water line, the ratio of one to two thousand and fifty-five nearly. The boiler was half full of water in these experiments."

To show the extent to which this foaming may take place, I quote an experiment in point.

"The steam in the boiler being not higher than two atmospheres, the following experiment was made. The level of the water was reduced until it stood just below the lowest gauge-cock. On opening this cock, steam at first flowed out, then water and steam; on opening the second cock, in addition, water flowed freely from the lowest, which was above the hydrostatic level; the foaming within the boiler, which was produced by thus relieving the pressure, was distinctly seen through the glass windows. On opening the third cock, steam and water issued from the second, which was two inches above the water level; and on partially raising the safety valve, water flowed freely from the second cock. A further rise of the valve filled the boiler with foam, water flowed freely out of the third cock, more than three inches and three quarters above the water level, and finally through the opening of the safety valve itself. In these experiments, an opening of .03 of a square inch in area, the lowest cock, which, to the area of the water surface, was as one to thirteen thousand seven hundred, caused water and steam to issue through a cock, below which the water was known to be. A further opening of .03 of a square inch, making, with the first, .06 inch, or one six thousand eight hundred and fiftieth the area of the water surface, brought water from the lowest cock; a total opening of .09 inch, (one four thousand five hundred and sixty-seventh of the area of the water surface) brought water and steam from the middle

\* Jour. Frank. Inst. vol. XVII. p. p. 8, 9, &c.

cock, indicating that the level of the water was nearly two inches higher than it really was.

A first apparatus, which was contrived for applying fusible plates to the boiler, suddenly opened an aperture of .95ths of an inch in diameter. Even at low pressures, the scalding contents of the boiler were violently discharged through this opening, against the roof of the experiment house."

But after all, will the steam produced by this foam coming in contact with the heated sides of a boiler, be greater in quantity than the escape steam which produces the foaming? M. Arago says, that in experiments which he made on the effect of opening a safety valve, the pressure was always diminished. But he remarks that the boilers on which he experimented had their full supply of water. His results do not therefore, decide the question. Indeed, the question being one of degree, is a difficult one. The Committee of the Franklin Institute endeavored to imitate the circumstances to be found in a boiler in which the water is low. Having allowed the water to waste, the bottom of the boiler above the water level became heated; openings of different sizes were made in succession, so as to produce different degrees of foaming. In every case an opening produced a diminished elasticity of steam.\*

M. M. Tabareau and Rey of Lyons,† found a different result by surrounding a small high pressure boiler with flame, allowing the water to become low, then opening a large stop cock. The pressure was increased.

These results do not contradict each other, they show that an increase of pressure may or may not be produced, *according to the quantity of hot metal present*. No one would probably venture upon making an opening under circumstances in which it was a mere question of degree whether the boiler would burst or not. At the same time the experiments of the committee led us to look further for causes to produce explosion from heated metal, by a sudden access of water. The choking of a forcing pump and the sudden removal, by the action, of the pump of the obstruction, the sudden introduction of water when it has been found very low, without putting out the fires, are occurrences which would produce a certain result. The last is entirely within the control of the engineer. In connected boilers occupying the breadth of a boat, the careening of the boat will cause just such a state of things. If continued long enough it cannot fail to produce an explosion.

Wherever there is unduly heated metal there is danger, and that danger may be actually increased by making an opening into a boiler, is the inference from this examination. Before leaving this subject, and after differing in the former essay entirely from Mr. Perkins, I am so well pleased to find some part of his suggestions well founded, that I am disposed to dwell upon it, I propose to examine whether the danger of explosion from hot metal will probably increase with the temperature, or not.

Finding that drops of water are repelled from heated metal at quite moderate elevations of temperature, the result has hitherto been assumed, as applying to the case of a steam boiler, of which the metal is unduly heated. Reflection will show that this is not the case, the heated metal is cooled by the very act of generating steam. The rapidity of the supply of heat is also to be taken into account. If the metal is directly above the fire receiving heat, the result will be very different from what would take place, were the heat derived from conduction, through the medium of other heated

\* See Jour. Inst. p. 14.

†*ibid*, p. 13.

parts of the boiler. The problem is in some sort indeterminate. This has been pointed out in the report of the committee on explosions, and experiments have been devised by using different modes of applying heat, to give an idea of the true state of the case.\*

They began by showing the early development of a repulsion in the heated metal, tending to diminish the vaporization of water, taking place when the quantity of water is too small to cool down the metal, at a lower temperature in copper than in iron, in a clean surface of metal than in one which is oxidated. This repulsion, preventing the effect of the increased difference of temperature in the metal, and the water to be vaporized produces a maximum in the vaporizing power of the metal. The vaporizing power of different metals at their maximum is different, being greater in copper than in iron, nearly in the ratio of the conducting powers of the metals. An important practical conclusion where the heat of the metal is kept up, as the temperature of greatest vaporization lies below that of our high pressure engines.†

By increasing the water, from drops to as great a quantity as the bowls, used in the experiments, would contain, and varying the circumstances by communicating heat to the metal through oil, and through tin, the Committee proceeded to examine the question now before us. While the quantities of water were small, great regularity appeared in the results, permitting a calculation of the temperature of greatest vaporization from results below that temperature.‡ The general conclusions are stated briefly thus:§

1st. The vaporizing power of copper, when supplied with heat, by a bad conductor or circulator, such as oil, increases with great regularity as the temperature increases, up to a certain point, the water being supposed thrown upon the copper surface, in small quantities. Copper flues, heated by air passing through them, would be in this condition if left bare of water, and then suddenly wet. This holds with copper one-sixteenth of an inch thick, without indication that a limit will be attained by a much more considerable thickness. The temperature at which the metal will have the greatest vaporizing power, is about 570° Fah., or about 230° below redness, according to Daniell.

The law of vaporization of small quantities of water, by a given thickness of copper, is represented with singular closeness by an ellipse, of which the temperatures represent the abscissæ, and the times of vaporization the difference between a constant quantity and the ordinates.

2d. The same power in thin iron, .04 inch thick, increased regularly, and was at a maximum, probably, at 510°. With thicker metal the power increases more rapidly at the lower temperatures, and varies very little, comparatively, above 380°, with thicknesses exceeding one-eighth, and less than one-fourth of an inch; attaining a maximum at about 507° Fah., when the quantities are small; rising to 550°, and much above, as the quantity of water is increased relatively to the surface of the metal which is exposed. Quadrupling the quantity of water, the entire amount being still small, nearly tripled the time of vaporization at the maximum.

3d. When copper of one-sixteenth of an inch in thickness, was supplied with heat by melted tin, a worse conductor, and having a lower specific heat than copper itself, the time of vaporization, in a spherical bowl, of quantities varying from one-sixteenth to one-half of the entire capacity of the bowl, increased but three-fold, and the temperature of greatest evaporation was raised by 56°, or from 470° to 526°. When the bowl had half of the portion which was exposed to heat filled, the weight of the water was about one and one-tenth of that of the metal.

4th. The times of vaporization of different quantities of water, varying from one-eighth of an ounce to two ounces, in an iron bowl one-fourth of an inch thick, and supplied with heat by the tin bath, were sensibly, as the square roots of the quantities, at the temperatures of maximum vaporization for each quantity.

\* Jour. Frank. Inst. vol. XVII. p. 152.

† Ibid. See p. p. 150, 151.

‡ Ibid. p. p. 152, 153, &c. and plates 5 and 6.

§ Ibid. p. p. 162-3.

## *Solar Eclipse of May 15th. Formula for Approximate Longitude. 97*

These temperatures were raised from about  $460^{\circ}$  to  $600^{\circ}$ , by increasing the weight of water about sixteen times, indicating that considerable quantities of water, thrown upon heated metal, will be most rapidly vaporized when the metal is at least  $200^{\circ}$  below a red heat.

5th. While a red heat, visible in daylight, given to a metal, even when very thick, and supplied by heat from a glowing charcoal fire, does not prevent water, when thrown in considerable quantities, from cooling it down so as to vaporize the water very rapidly, it is much above the temperature at which the water thrown upon the metal will be most rapidly evaporated. Thus one ounce of water was vaporized in thirteen seconds, at about  $550^{\circ}$ , in a wrought iron bowl one-fourth of an inch thick, and required 115 seconds to vaporize in a cast iron bowl one-half an inch thick, at a red heat. Four ounces in the latter bowl vaporized in about 300 seconds, the bowl being red hot when it was introduced; and two ounces vaporized in thirty-four seconds at  $600^{\circ}$  Fah.

6th. The temperature of greatest vaporization, with a given thickness of metal, is lower in copper than in iron, the repulsive force being developed at a lower temperature. With equal thicknesses of iron and copper, the vaporizing power of the latter metal, at its maximum, was, with the oil bath, one-third greater than that of the former, and with the tin bath the power of copper .07 of an inch thick, was equal nearly, to that of iron, one-fourth of an inch thick, each being taken at its maximum of vaporization, for the different quantities of fluid employed. As the maxima for the iron are higher than those for the copper the advantage will be still greater in favor of copper when the two metals are at equal temperatures.

7th. The general effect of roughness of surface is to raise the temperature at which the maximum vaporization occurs, and to diminish the time of vaporization of a given quantity of water at an assumed temperature below the maximum.

8th. Though it has been shown that water thrown upon red hot metal is adequate to produce explosive steam, even when it does not cool the metal down to the temperature of most rapid vaporization, it is not the less true that metal more than two hundred degrees below a red heat, in the dark, is in the condition to produce even a more rapid vaporization of water thrown upon it, than when red hot.

We thus acquire a certainty of this remarkable fact, that a boiler may be in a more dangerous condition; (that is, in a condition more fit to produce suddenly highly elastic steam,) when below a red heat, from water thrown upon the metal, than even when the danger shows itself by the luminousness of the metal. Although, as we have seen, explosion may be produced at a red heat.

We are by all this plainly directed to the necessity for keeping up the supply of water in a boiler. A keen interest is excited as to the means of ascertaining this level. The necessity for methods of showing when the metal of the boiler becomes hot, before it has reached the point when it becomes dangerously so, is clearly proved. All these important practical matters the reader will find treated of, in the report from which I have drawn the materials of these essays.

But to return to the theory of Mr. Perkins. We have followed up two of his positions, and have now arrived at the third. "The *third* and less frequent kind, [of explosion] although most terrific, is undoubtedly caused by an explosive mixture having been formed in the boiler." This "third kind" I propose to examine by the same light which has enabled us to separate truth from error in the first and second. D.

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### Physical Science.

*Communication of a formula for facilitating the reduction of observations of the solar eclipse of May 15th, 1836. By S. C. WALKER.*

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN: The formulæ communicated by me in the April number of the Journal, were intended for announcing the time of the principal phases  
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of the solar eclipse of May 15. By applying a correction derived from observations made under a known meridian, they may be used for determining the longitude of places at which it was observed, when not too far distant from Philadelphia, for which place alone, they are strictly correct. The error of the middle time of the eclipse, as deduced from the formula, amounts to one second of time for New York and Albany, to two seconds for Baltimore and Washington, and to eight seconds for Boston and the University of Virginia. By applying to the middle time by the formula, a correction depending upon the first and second powers of the difference of longitude from Philadelphia, results may be obtained, in which the greatest variation from a rigorous computation for the above places, will in no instance exceed 0.6 sec., and in which the average discrepancy will not exceed 0.4 sec. In the former communication it was omitted to mention that  $l$ , denotes the *geocentric* latitude of the place for which the computation is made.

Retaining the same notation and constants as before, we have for the resulting longitude of the place of observation from Greenwich, +East—West

$$\lambda = A + B + C$$

Where,

$$A = \lambda' + x + \{M - M'\} - [8.8557] \{D - D'\}$$

$$B = [4.9781] \{5 \text{ h. } 0 \text{ m } 40 \text{ s.} + A\}^2 - [7.1701] \{5 \text{ h. } 0 \text{ m. } 40 \text{ s.} + A\}$$

$$C = -\frac{1}{5} \{A + B - \lambda'\}$$

In these equations

$\lambda'$  = Assumed longitude from Greenwich, in seconds of time.

$M$  = Local mean time of middle, observed.

$M'$  = do. computed by formula.

$D$  = Duration, observed,

$D'$  = do. computed,

$x$  = A correction for the errors of the tables.

The unknown quantity  $x$ , is the mean of the times at beginning and end, in which the moon by its apparent motion, traverses a space equal to the tabular error on its true orbit, projected upon its apparent orbit. No material error will arise from assuming  $x$ , as constant for the limits to which this formula extends. Of the extent to which it may be used, an opinion may be formed from the following table, in which the middle time  $M' + B$  derived from it, is compared with the rigorous computations for several places in the American Almanac.

Place.	M'	B.	Middle by Formula M' + B	Middle by Am. Almanac.	Difference.
Philadelphia,	8 17 55.35	+ 0.00	8 17 55.35	8 17 54.75	+ 0.60 s.
Boston,	8 42 30.80	+ 7.73	8 42 38.53	8 42 38.90	— 0.37
Providence,	8 39 42.55	+ 6.31	8 39 48.86	8 39 48.65	+ 0.21
Albany,	8 30 11.15	+ 0.60	8 30 11.75	8 30 11.80	— 0.05
New York,	8 25 1.45	+ 0.32	8 25 1.77	8 25 1.65	+ 0.12
Baltimore,	8 9 40.95	+ 1.69	8 9 42.64	8 9 43.20	— 0.56
Washington,	8 6 58.30	+ 2.56	8 7 0.86	8 7 0.30	+ 0.56
University of Va.	7 58 10.33	+ 7.37	7 58 17.70	7 58 18.15	— 0.45
					8)2.92
Greatest difference, 0.6 sec.			Mean difference, 0.36 s.		

# Solar Eclipse of May 15th. Formula for Approximate Longitude. 99

The determination of  $x$ , requires observations under known meridians. This eclipse having been visible at European observatories, the value of  $x$ , will admit of accurate computation. If we assume the longitude of Independence Hall, Philadelphia, at 5h. 0m. 40s. west from Greenwich, we shall have, after correcting for the small differences of longitude of several places of observation in Philadelphia, the following values of  $x$ ,

By the observations of R. M. Patterson, M. D.	$x = - 11.15$ sec.
“ T. M'Euen, M. D.	$x = - 9.67$
“ W. H. C. Riggs,	$x = - 11.40$
“ S. C. Walker,	$x = - 11.93$
	<hr/>
	44.15
Mean of four observations,	$x = - 11.04$

As an application of the formula, let it be required to deduce the longitude of the Capitol at Washington, from the observations of F. R. Hassler, Esq. Latitude  $38^{\circ} 52' 54''$  Beginning observed 6h. 53m. 58s. End at 9h. 20m. 8s., A. M. Mean time.

Computation of the longitude of the Capitol.		1st. Approximation.	2d Approximation.
(1) ....	assumed $\lambda'$	- 5h. 8m. 7.20	- 5h. 8m. 10.02
(2) ....	assumed $\lambda$	- 11.04	- 11.04
	M	+ 8 7 3.00	+ 8 7 3.00
	M'	+ 8 6 58.30	+ 8 6 54.88
(3) ....	M-M'	+ 4.70	+ 8.12
	D	+ 2 26 10.00	+ 2 26 10.00
	D'	+ 2 26 13.60	+ 2 26 12.24
	D-D'	- 3.60	- 2.24
(4) ....	- [8.8557] { D-D' }	+ 0.26	+ 0.20
(1)+(2)+(3)+(4) ....	A	- 5 8 13.28	- 5 8 12.74
	5h. 0m. 40s. + A	- 7 33.28	- 7 32.74
(5) ... + [4.9781] { 5h. 0m. 40s. + A }	$\}^2$	+	+
			1.92
(6) ... - [7.1701] { 5h. 0m. 40s. + A }	$\}$	+	+
			0.67
(5)+(6) ....	B	+ 2.56	+ 2.59
	A+B	- 5 8 10.72	- 5 8 10.15
	A+B- $\lambda'$	- 3.52	- 0.13
	$-\frac{1}{5} \{ A+B-\lambda' \} = C$	+ 0.70	+ 0.03
A+B+C	= $\lambda$	- 5 8 10.02	- 5 8 10.12

Similar computations from John Gummere's observations, give the longitude of Haverford School.

Observed beginning	7h. 3m. 24.5s.
“ end	9 31 47.
“ latitude	$40^{\circ} 1' 12''$
assumed $\lambda''$	5h. 1m. 26.8s.
First approximation $\lambda'$	5 1 16.94
2d “ $\lambda$	5 1 16.15

*Observations of the Solar Eclipse of May 15th, 1836. Communicated by direction of the American Philosophical Society.*

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN:—By direction of the Amer. Philos. Society, I send you an abstract of the observations of the late solar eclipse, which have been communicated to the Society. It is not complete, some particulars being required which will probably be obtained from the observers, by the committee to whom the observations have been referred, to prepare them for publication in the Society's transactions.

The times of beginning and end are in mean time of the places of observation.

Very respectfully yours,

A. D. BACHE,  
*One of the Secretaries, Amer. Philos. Soc.*

*Table of observations of the beginning and end of the solar eclipse of May 15th, 1836, as observed at Philadelphia, &c.*

Places of Observation.	Time of beginning of Eclipse.		Time of end of Eclipse.		Observers' Name.	REMARKS.		
Philadelphia.	h.	m.	s.	h.	m.	s.		
1. Hall of Am. Phil. Soc	7	3	45.8	9	32	38.3	Dr. R. M. Patterson,	
2. Dr. McEuen's house,	7	3	38.0	9	32	38.1	Dr. T. McEuen,	2770 feet west of Philos. Hall.
3.        “	7	3	50.0	9	32	26.5	Mr. W. H. C. Riggs,	
4. No. 100 S. 8th st.	7	3	40.9	9	32	44.1	Mr. S. C. Walker,	1340 feet west of Philos. Hall. Teles.
5. No. 231 Market st.	7	3	41.0	9	32	34.0	Mr. Sellers,	42 inches achrom.
Haverford school,*	7	3	24.5	9	31	47.0	Mr. Jno. Gummere,	Telescope 42 inch. achrom.
Germantown, Pa.	7	3	54.5	9	32	44.5	Mr. Isa. Lukens,	
	7	3	55.5	9	32	49.5	Mr. C. Wistar,	Telescope 3 feet achrom.
Phoenixville, Chest. co. ‡	7	3	12.0				Mr. H. Wilson,	
West Hills, L. I. §	7	12	48.5	9	43	40.0	Mr. J. Ferguson,	Large repeating circle of coast sur- vey, used for obser-
Washington City,	6	53	58.0	9	20	08.0	Mr. F. R. Hassler,	[vations.]

\* Assumed lat.  $40^{\circ} 01' 12''$ . Long. 5h. 01m. 25s. † Doubtful.

‡ Assumed lat.  $40^{\circ} 08' 07''$ . Lon. deduced by H. Wilson, from eclipse, 5h. 01m. 57s.

§ One of the station points of the coast survey. Lat.  $40^{\circ} 48' 49.2''$ . Long.  $73^{\circ} 26' 12''$ .

*Essays on Meteorology.* By JAMES P. ESPY, Mem. Am. Philos. Soc., &c.  
No. III.

*Examination of Hutton's, Redfield's and Olmsted's Theories.*

In the preceding essays many facts independent of theory, have been adduced to prove an upward motion of the air in the region of a cloud, and many more will be adduced hereafter.

At present I propose to examine one of the many phenomena which I think can be explained by this upward motion only; I mean the great quan-

tities of rain and hail which sometimes fall in a very short time. It was demonstrated in the first part of this essay, that the velocity of the upward vortex, in very favorable circumstances, is 4.5 miles a minute. In rising through that height it will precipitate a little more than one half its vapour, which will be about five inches of rain, so that in this case forty inches would be precipitated in eight minutes, provided it were all to fall in one place, which from the nature of the vortex, can seldom occur. That which is condensed above the point of perpetual congelation, should not be taken into the account; because at the moment of its condensation it becomes snow, and being so light will remain in the atmosphere long after the hail and the rain caused by the melting of the finer masses of hail, in passing down through the lower parts of the atmosphere, have reached the earth. Still there will be enough left to account for the most violent rains or hails, of which we have any account.

Here it may be worth while to turn aside for a moment, to examine the efficiency of the most plausible theory of rain that has ever been given to the world. I mean that of Dr. Hutton. He supposes two currents of air of different temperatures, both nearly saturated with vapour, to be mingled together, and that a precipitation of course takes place, in accordance with the known fact, that at their mean temperature all their vapour cannot be retained, and therefore the surplus will be precipitated. This theory is defective in two respects: First, it does not show how two currents of air could be mingled to any considerable extent; and second, it does not show by calculation, that rain to any considerable amount, would be produced, even if large masses of air at very different temperatures, should be mingled together, which it would be easy to show never can happen, especially in the torrid zone. It may fairly be presumed that no advocate of the Huttonian theory, would suppose that more than 500 feet of a stratum of cold air could be mingled with a stratum of warm air, 500 feet of perpendicular height. Now it will be found by calculation, that if one of these strata is at 60°, and the other at 40° and both saturated previous to their mixture, the whole amount of precipitation, provided they took the mean temperature of 50°, would be less than a grain and one half on each square inch of surface. But as the latent caloric evolved in the condensation of the vapour, would not suffer the mean temperature of the two strata, when mixed to be acquired, but some temperature above 50°, therefore a less quantity than that mentioned, would be precipitated. Such a quantity in most cases, would be entirely evaporated in passing down through the air below, and never reach the earth.

It was mentioned before that 5.1 inches of rain fell in Wilmington, on the 29th of July, 1834, in two and a half hours; let us see whether such a rain could be produced at all, on the Huttonian principles, making the most extravagant allowance for the quantity of air mingled, and also for the difference of temperature of the two strata.

Let us suppose then that one half of the atmosphere at 80° Fah., should be mingled with the other half at zero, over the region round Wilmington, and that 5.1 inches of rain is the result. What will be the temperature of the mingled mass after the rain? The mean temperature is 40°, which would be the temperature after the mixture, if no latent caloric is given out in the condensation of vapour. But from the principles explained before, it will be found, that as five inches of rain, is  $\frac{5}{400}$  of the whole atmosphere in weight, the latent caloric given out in the condensation of the vapour forming this rain, will be sufficient to heat the whole compound 59.7°, which be-

ing added to the mean temperature  $40^{\circ}$ , will make the temperature of the air after the rain  $99.7^{\circ}$ , almost  $20^{\circ}$  hotter than the hottest half of the atmosphere before the mixture.

This result, however unexpected, ought not to appear surprising. For if gentlemen will frame theories on loose principles, without once putting these principles to the test of calculation, and without even taking the least notice of the latent heat of vapour, or the specific heat of air, they ought not to be surprised that a little plain arithmetic should dissipate their empty visions and "leave not a wreck behind."

Theorists will pardon me for this sweeping denunciation, when I now voluntarily come forward and plead guilty to the same charge; for I too have framed a hypothesis to account for rain, and advanced it under the high sounding name of theory.

Having found that the Huttonian theory would not bear the test of calculation, I imagined there was but one other possible mode of condensing vapour and that was that the vapour by its own elasticity in the lower parts of the atmosphere, thrust itself up into a cold stratum above, when ever such a one overlapped the one below, and was thus condensed into rain.

This hypothesis I thought was altogether reasonable from the great discovery of Dalton and Gay Lussac, that vapour in the atmosphere rests only on vapour, and thus forms an independent atmosphere, and is not supported in the least degree by the air. I imagined then, that vapour could rush with great velocity from air where the dew point was high, to air where the dew point was low. But when I discovered that some rains were so great as to be beyond the power of this theory too, I began to suspect the hypothesis itself, which induced me to put it to the following trial.

I united two glass retorts together by their necks, then having covered one with snow, I put ten drops of water into the other and placed it in a vessel of water at the temperature of  $130^{\circ}$ , and let it remain in that situation seven hours, the temperature of the room during the experiment being about  $70^{\circ}$ ; not one drop was distilled over in all that time.

I then took the retorts apart, leaving open the neck of the one having the water in it; it has continued in the room, open now for thirty days, with a temperature of  $70^{\circ}$  night and day, and the dew point in the room never as high as  $40^{\circ}$ , the ten drops of water being now only slightly diminished.

This refutes the hypothesis of rapid permeation of air by vapour, and indeed, proves that vapour, like heat, when it passes up to the upper regions, must be carried by the air, and not thrust up by its own elasticity. But to return from this digression; if the Huttonian theory is unable to produce such a rain as that at Wilmington, what will it do with the one which occurred at Geneva, on the 25th October, 1822, when it rained thirty inches in twenty-four hours; or the one at Jeyeuse, on the 9th October, 1827, when it rained thirty-one inches in twenty-two hours?\*

Or how will it account for a storm of hail† which fell in Orkney on the 24th of July, 1818, in the afternoon, nine inches deep in less than nine minutes? And here it may be remarked that this is the storm mentioned before, in which the barometer was observed to fall two inches, near the end of the storm, when it was not nearly so violent as it was in other places. Or how will it account for the immense quantity of rain which fell at Catskill, New York, on the 26th July, 1819?

\* Edinburgh Trans. 1823.

† Pouillet *Eliesmen de Phisque*, II. 758.

About half past 5 P. M. a dense black cloud rose up from the S. W. accompanied with a fresh wind, and about the same time, or a little after, a very thick dark cloud rose up rapidly from the N. E. They met immediately over the town; at this instant a powerful rain commenced.

As soon as the clouds met they seemed to fall down on the river over which they met, and then the cloud rested on the water in such a manner that no space could be seen between them. For half an hour there was no appearance of drops of rain, the water appeared to descend in large streams and sheets. In this half hour the quantity fallen was above twelve inches on a level. Two persons testify that some time after the clouds met, they saw at the same moment a water spout rising up from the river nearly opposite, with a broad bottom ascending to the clouds with a whirling motion, in the form of a pretty regular cone.

The whole quantity which fell was more than fifteen inches, over a space of about eighty square miles; and as far as I can collect from the whole account which is given at large in Silliman's Journal, vol. 4, p. 124, this spout was stationary.

The intelligent author of the account, Benj. W. Dwight, says, it is worthy of remark that eleven days before in the P. M., there fell in a shower of short continuance, more than six inches of rain.

This theory has lately been brought forward and extended by Professor Olmsted of Yale College, with a view of accounting more particularly for hail, than the original author of the theory had done. And though I am aware that the strength of my theory does not depend on the weakness of any other, I think it proper to give the Professor's remarks a passing notice.

"We assign," says Mr. Olmsted, "as the cause of hail storms, the congelation of watery vapour of a body of warm and humid air, by its suddenly mixing with an exceedingly cold wind, in the higher regions of the atmosphere. Let us examine, says he, the effects which would result from the meeting of two opposite winds, at the height of 10,000 feet, during the heat of summer, the one blowing from the latitude of 30°, or from the confines of the torrid zone, and the other from the latitude of 50°, or the northern part of British America. If they had equal velocities, they would meet at the parallel of 40°; and, as in the case of the Gulf stream, a fluid does not readily change its temperature, merely by flowing through a body of the same fluid of a different temperature, and especially air through air, each current would retain nearly its original temperature.

The southerly wind blowing from a point which is still 2,000 feet below the line of perpetual congelation, is comparatively warm, while the northern coming from a point 4,000 feet above the same boundary of the empire of frost, will have a degree of cold, probably surpassing any with which we are acquainted. We infer from our preliminary principles, that immediately on meeting, the watery vapour of the warmer would be frozen with an intensity corresponding to the temperature of the colder current; that the minute hail stones thus formed and endued with such excessive cold, would begin to descend, and accumulate to a size proportionate to the intensity of the cold of the nucleus, and to the space through which they descended, and to the humidity of the lower strata of the atmosphere; that is, the colder they were when they began to fall, the farther they fell, and the more humid the air, the larger they would become."

As Professor Olmsted has not shown how these currents could be generated, the theory is plainly incomplete on this ground. And besides, even if they

should be generated, it does not appear how they could be mixed; for either they would meet each other in opposite directions, and so stop each other's motion without mixing to any great extent, or they would slip by one another without much affecting each other's temperature, according to the Professor's own reasoning.

But even if it could be shown that a mixture of two currents could take place suddenly, of even 1,000 feet in perpendicular extent, it has been proved already that under much more favorable circumstances, the dew point being higher, a grain and a half of rain to the square inch would not be precipitated, and that in most cases not a particle of this would reach the ground, for it would be evaporated in its descent, unless the air below should happen to be absolutely saturated with vapour, which seldom occurs.

But, according to Mr. Olmsted, "the minute hail stones being indued with a cold probably surpassing any with which we are acquainted, would begin to descend and accumulate to a size proportioned to the intensity of the cold of the original nucleus."

This remark is erroneous in two respects. First, the cold is certainly not more intense at this great elevation, than one degree for every 100 yards, and is therefore in the northern current only  $13\frac{1}{3}^{\circ}$  below the freezing point; for by supposition it was only 1333 yards above the line of perpetual congelation, when it left latitude  $50^{\circ}$ .

Second, the original nucleus would not accumulate in the manner described; but on the contrary it would be entirely melted by the time it had descended far enough into the air below the line of perpetual congelation, to have condensed vapour less than one-seventh of its weight. This will easily be perceived by comparing the relative latent heats of vapour and of water, and this too even if it received no heat from the warm air into which it fell. But even if the original nucleus were of the temperature of the interplanetary spaces,  $57^{\circ}$  or  $58^{\circ}$  below zero, it would not increase one-fifth in size by condensing on itself the vapour, before it would be entirely melted by the disengaged latent caloric.

Professor Olmsted concludes his essay by saying that the momentum of a hail stone would be one hundred times greater if it did not at every stage of its progress down to the very ground, receive new accessions of watery vapour, which being matter at rest, is to be put in motion by the falling body, and consequently its speed is continually retarded.\* But he must now perceive, from what has already been said, that the velocity of descent will not be diminished one-fifth, even when the stone has received an addition of vapour great enough to melt it.

Before I take leave of this extension of Hutton's theory, I must take notice of another remark made by Professor Olmsted, which if correct, would of itself prove fatal to the theory which I have advanced. He says, "we have certain evidence from the concurrence of opposite winds, and from the density and consequent blackness of the clouds, that a great condensation takes place in the region of the storm."

Now it appears to me that it would be much easier to account for the concurrence of winds, by supposing a rarefaction in the region of the storm, just as the rarefaction in a chimney is the cause of the air in the room moving towards the fire place. It shall be shown hereafter what effect would be produced by a condensation in the region of a storm.

I come now to a most important part of this investigation, the northeast

\* Vide Silliman's Journal, vol. 18, p. 1.

storms of the Atlantic states. It is well known since the days of Franklin, that these storms commence in the south west and travel towards the north east with a velocity which varies at different times and places, and that the wind always blows from some eastern point at the commencement of the storm.

Mr. Redfield of New York has collected a great many highly interesting facts connected with these storms, of which some of the most important shall now be detailed.

When a storm commences within the torrid zone it travels west of north until it reaches lat.  $30^{\circ}$ , when it has become nearly north, it then gradually deflects more and more east of north, until about lat.  $40^{\circ}$ , it is moving about N. E. That these storms are probably nearly round, varying in diameter, and more slow in their advance along the coast, in proportion to their size, and also slower in low latitudes than in high. That on their north western side, the wind sets in more northerly and changes round during the storm by north, and on the south east side of the storm the wind sets in at the commencement more easterly and south easterly, and changes round by the south.

Mr. Redfield thinks that these facts can only be accounted for on the supposition, that these storms are exhibited in the form of great whirlwinds.

As a more particular proof of this position, he details the facts which occurred in Connecticut, as one of these storms passed there in 1821. He says, "that the mass of atmosphere upon the earth's surface was moving for several hours, apparently towards the N. W. over Middletown, with a probable velocity of seventy-five or one hundred miles per hour, while in the northern parts of Litchfield county, at a distance say of forty miles, the wind, at about the same period, was blowing with nearly equal violence in the opposite direction towards Middletown." Now it will appear by a little reflection, that all these facts agree with the idea of an upward vortex, more consistently than with a horizontal whirlwind.

Indeed I do not hesitate to say, that the last fact is inconsistent with a horizontal whirlwind, and proves with irresistible evidence, the existence of an upward vortex, at least in this storm. For two winds cannot blow towards each other for several hours as here described, without either rising upwards when they meet, or blowing outwards at the sides. But we have proof positive, that they did not blow outwards at the sides, for at N. York, S. W. of the point between Middletown and Litchfield, to which the winds from those places were blowing, the wind changed round by the N. to the N. W., or W. about the time these winds began to blow violently. And we have strong reason to believe that it did not blow outwards to the N. E.; for at the commencement of the storm, through its whole course, the wind always blew from some eastern point.

There is one conclusion which Mr. Redfield draws, which I do not find to be justified by the facts detailed in this storm. "That along the central portion of the track, the storm was violent from the south eastern quarter, *changing suddenly to an opposite direction.*" Now I find, that of fifteen points on the south east side of the storm, at which the wind set in S. of E. only two, Bridgeport, Conn. and one at sea, forty miles north of Cape Henry, are given, as having the wind to change round, even as far as the west. These two, I *suspected* as being contrary to my theory; and upon examination of the newspapers of the day, I find that they report the wind at both these places to have changed round only to the S. W., just as far as it *should* change to satisfy my theory.

All these facts lead to the conclusion, that in this storm, at least the wind in the neighborhood of the storm, blew directly towards its centre, and if so, it follows beyond all doubt, that there was an upward vortex in the middle of the storm. Now as it is impossible to conceive of an upward vortex being formed in the region of the storm, if there is a condensation of air there; so it can only continue on the supposition that the air, as fast as it arrives in the vortex from all sides, becomes rarefied, whatever may be the cause of that rarefaction.

As it has been said that a condensation in the region of the storm would cause an afflux of air there, let us for a moment examine the assertion. Suppose that no latent caloric is given out in the condensation of vapour, and that in a circular space of one hundred miles in diameter, five inches of rain have fallen, the whole condensation which would take place by the change of vapour to water, would be less than a fiftieth of the whole atmosphere, and the air on all sides of the storm, would not have to move one mile towards the centre, before the equilibrium would be restored. Besides it is manifest that this motion could not take place at the surface of the earth, but rather in the region of the cloud and above it. And even if the velocity at the surface of the earth is supposed to be as great as in the region of the cloud, it could not be a mile an hour, for it never has been known to rain five inches an hour in a storm of this magnitude, and the condensation of the air is supposed to take place during the whole rain.

I have myself had the pleasure of seeing and pointing out to many of my friends at various times, particularly to Professor Bache, the clouds moving outwards above, and inwards below, during a summer's thunder gust, which could not be, if there was a condensation of air in the region of the cloud, and I may add without the fear of contradiction, that it proves the reverse. Besides, I have known many instances of long continued and violent rains in the south, during the prevalence of a strong and long continued north wind, and of long continued and violent rains in the north, during the strong and long continued south wind.

An instance of the latter occurred on the 11th, 12th, 13th, 14th, and 15th of May, 1833. In my journal it is stated that a strong south wind prevailed during this whole period night and day. And by consulting the papers of the period, I find the following facts:

*Harrisburg, May 16, 1833.* When our paper went to press the Susquehanna was sixteen feet above low water mark, and rising—a greater freshet than has taken place for sixteen years—the rain must have been much greater up the river than in the vicinity.

*Albany, 15th.* The most painful accounts begin to be received of the destructive effects of the freshet. The river continued to rise until 10 o'clock this morning, when it was a foot higher than it was in the great freshet occasioned by the ice in the spring. On the 17th, it had fallen only a few inches.

The *Amsterdam* (Mohawk Herald) of the 16th, says, "every bridge and mill dam on the creek near Fort Johnson has been swept away."

*Hartford, 18th.* The water in the Connecticut last evening, was 19½ feet above low water mark.

*Montreal, May 15th.* A larger quantity of rain has fallen here since midnight of last Friday, (five days) than we have had for a considerable period past, and the rain is now falling in torrents, the atmosphere cool and very unpleasant.

The *Goshen Patriot*, says the Delaware rose twelve feet above an ordinary freshet—not a raft above Milford was preserved entire.

These facts afford conclusive evidence that in this case at least, the wind at Philadelphia blew hard for five days, exactly towards one of the greatest rains which our country has ever witnessed. And the statement, that the atmosphere at *Montreal* was cool and very unpleasant, would lead us to suppose that the wind there was coming from some northern quarter; for during this whole period the temperature was very high in Philadelphia, the mean minimum being  $65^{\circ}$ , and the mean maximum  $76^{\circ}$ , and if a southern wind prevailed there, it is not at all likely that the air would have been cool and unpleasant.

Again, from the 3d of June, 1835, to the 12th of the same month, the wind was constantly from the north, with one exception from north east, pretty strong for a considerable portion of time.

I find by the *Charleston Courier*, that a dreadful storm of rain set in there on the 3d, and another very violent one on the 8th, which was increasing when the paper went to press on the 9th at 10 P. M., and that on that day there had been no mail from Fayetteville, and that there were six letter mails due from N. Y. and Boston, and five from Washington, Baltimore, and Philadelphia.

All these facts seem utterly at variance with a horizontal whirlwind; and entirely consistent with an upward vortex, if they do not absolutely prove one.

If Mr. Redfield should perceive that all the interesting facts which he has with such laudable industry collected, are fully explained by a theory which accounts also for the rain, I am sure he will not be very tenacious of his horizontal whirlwind; especially when he does not pretend to show that either the whirlwind is the cause of the rain, or the rain the cause of the whirlwind. Let us, however, examine for a moment (for I should be proud to enlist Mr. Redfield under the banners of a true theory) what would be the phenomena, on the supposition that there is a horizontal whirlwind, say of one hundred miles in diameter, moving with a velocity of seventy-five miles an hour, or 110 feet per second. It is demonstrated in mechanics that if a body moves in a circle, with a radius of sixteen feet, and a velocity of sixteen feet per second, its centrifugal force will be equal to its gravity. And as centrifugal force is directly as the square of the velocity, and inversely as the radius, the centrifugal force of the air in this whirlwind is ascertained by the following proportion:

$$\frac{16^2}{16} : 1 \text{ (gravity)} :: \frac{110^2}{25 \times 5280} : \frac{1}{74} \text{ or } \frac{1}{74} \text{th part of the gravity.}$$

And as a wedge of air fifty miles long is about eight times as heavy as a column of atmosphere equal to its base, its whole centrifugal force will be  $8 \times \frac{1}{74}$  of fifteen pounds to the square inch, which would cause the barometer to rise about  $1\frac{4}{10}$  of an inch in the borders of the storm, both at its commencement and termination; and cause a motion of the air outwards due to this pressure, which would be about 280 feet per second, according to the principles established in a previous part of this essay. Now these two phenomena are entirely wanting in all N. E. storms; for the air does not blow outwards from the storm, nor does the barometer rise at the termination above the mean, though it sometimes does at the commencement, for a reason which shall hereafter be explained. Besides, if such a whirlwind could be generated, it is manifest that it would soon be destroyed by its

outward motion, unless some mighty cause exists, of which we have no knowledge, to generate new motion in the air, which would descend from the upper regions of the atmosphere in the middle of the whirlwind, to take the place of that which had thrust itself out by its centrifugal force. It may be added, that the readiness and ease with which the air would descend in this whirlwind, would be so great that the rarefaction of the air in the inside, caused by the centrifugal force of the air would be a quantity very minute, unless we suppose the whirlwind to reach to a great height, which cannot be the case, if it is produced by friction on the West India Islands, and on our coast, as is alleged.

Therefore, it will not account for the great fall which is known to take place in the barometer, during these violent storms, a fact which is fully explained by the theory here proposed. Besides, Mr. Redfield need not be told that this downward motion of the air in the centre of the whirlwind, would increase its capacity for vapour, and effectually prevent deposition.

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### **Bibliographical Notices.**

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*Concise decimal tables for facilitating Arithmetical calculations, &c., designed for practical men.* By TIMOTHY CLAXTON, Boston. Published by the author.\*

A sheet containing one of the most concise series of tables which we have ever seen, for facilitating arithmetical operations, has been published by the author, Mr. T. Claxton of Boston. It is accompanied by a pamphlet explanatory of the tables, and containing also an exposition of the system of decimal fractions, a list of data from which the tables are compiled, and an index to them.

The tables may be classed as mathematical, mechanical and miscellaneous. The former contain tables for finding the circumferences and areas of circles from their diameters, the diameters from the circumferences, and square roots of the areas, the side of a square equal in area to a circle from the diameter or circumference given, &c., the solidity of a cone from the square of the diameter of its base, and its height, and a sphere from its diameter, &c. &c. Among the mechanical tables are a series for the reduction of weights and measures, for calculating the weights of solid and hollow cylinders of cast-iron, the weight of square and round bars of iron, of spheres of cast-iron, lead, &c. all from convenient data. Among the miscellaneous tables, are those for reducing sterling money to dollars, or vice-versa, the amount of rent or salary for any number of days, having the annual amount &c. &c. There are in all, forty-eight tables conveniently arranged upon a sheet of 10 by 13 inches which may be hung up in the counting-house, or folded for the pocket, for reference.

These tables recommend themselves highly for convenience, and as far as we have examined the calculations we have found them correct. B.

\* The Franklin Institute owe to the liberality of the author a number of copies of these tables, which he has requested may be distributed among the members. His object in the publication, is the dissemination of what he justly conceives to be useful matter.

Com. Pub.

*The Steam Engine familiarly explained, with a historical sketch, &c., by the* Rev. DIONYSIUS LARDNER, *with additions and notes by* JAMES RENWICK, L. L. D., *Prof. of Nat. Exper. Philos. and Chem. Columbia College, N. Y.* Second American from the fifth London edition. Philadelphia, Carey and Hart, 1836.

This is a new edition of *Lardner on the steam engine*, presented in an enlarged form, and with considerable improvement in both the matter, and the manner of getting up the work.

The principal additions consist of a view of steam navigation, a description of important points connected with the economy of steam power, and compendious maxims for the guidance of those engaged in rail-way enterprises. Besides these, there are minor additions and improvements. We have often heard it urged by practical men, that they have been disappointed in the information given by Lardner, in the former editions of this work. This was plainly because they expected to get from the book information which it was not intended to give. It is not intended to furnish a practical discussion of the steam engine, either stationary, as applied to navigation, or to locomotion on common roads and rail-ways; of course the reader who consults it for such a purpose, must experience disappointment. But the general reader, or the student who wishes to obtain a correct idea of the principles of the steam engine in its various applications, will be gratified by the lucid descriptions, the happy arrangement and manner of the author, the easy style with which the subject flows; and will find when this work has been carefully read, if he wishes to go deeper into the subject, that he can consult more profound treatises, with many fold the advantage which he would have derived, without this previous preparation. This is of course not the place for a particular review of the minutiae of the work, but in conclusion, we may add, that we consider it as materially increased in value, by the general accuracy of the American edition, which is guaranteed by the name of Professor Renwick.

B.

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## Franklin Institute.

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### *Monthly Conversation Meeting.*

The Ninth Monthly Conversation Meeting of the season was held at the Hall of the Institute, on the 26th of May.

Mr. Chas. F. Voorhies, of Philadelphia, exhibited a portable printing press of very compact form, designed for card printing and other light work.

Mr. Allen Ward, explained the principles upon which he constructs his scales of equal parts, for the use of tailors, and exhibited several diagrams illustrative of the method of adapting the scale to the peculiarities of shape, and the variation of fashion. Mr. W. has been very successful in reducing to mathematical precision, this intricate art.

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### COMMITTEE ON SCIENCE AND THE ARTS.

#### *Report on Mr. Amasa Holcomb's Reflecting Telescope.*

The Committee on Science and the Arts, constituted by the Franklin Institute of th  
Vol. XVIII.—No. 2.—August, 1836.

State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Reflecting Telescope, invented by Mr. Amasa Holcomb, Southwick, Massachusetts, REPORT:—

That the following description of the instrument, submitted to the Committee, is given by Mr. Holcomb, viz:

"It is of the reflecting kind, having the front view, and has a focal length of about nine and a half feet, and an aperture of eight and a half inches. It has six eye pieces, of powers from ninety to nine hundred and sixty."

The evenings of the 22d and 23d of April, proving unfavorable, a third trial was made on a following night, when the performance of the instrument was very satisfactory. It is of the same size as the largest submitted last year. The mechanical execution of the mounting is quite superior, and leaves little to be desired, whether we regard steadiness, convenience in command of the instrument, or facility of finding objects.

The committee do not hesitate to pronounce this instrument superior in performance to any that have yet been exhibited by Mr. Holcomb.

The ring of Saturn was seen to be double by all the members of the committee present, the dark space between the rings could be observed on each ansa, half way to the conjugate axis of the perspective ellipse, under which it was viewed.

ζ Bootis which last year was so far separated that the discs became tangent to each other, presented the same appearance this year, with a power of 250. But with a power of 960 the dark space between the stars was equal to one-fourth of the disc of either.

In ζ Cancri, the close pair, distant about  $1''.1$ , were so far separated that the dark space was visible as a line between them. This was considered too difficult for either of the telescopes exhibited last year.

A power of 960 was used in examining γ Virginis. This remarkable pair, of which the distance is  $0''.8$ , according to Herschel's ephemeris, or  $0''.6$ , according to Struve's late measurements, gave no indications of being double.

This instrument was made to order for John A. Fulton, Esq. of Chilicothe, Ohio, a gentleman whose liberal encouragement of this department of the arts is worthy of all commendation. While, however, the committee would applaud the patriotism of those individuals, or corporate bodies, who encourage American artists, they cannot but remark, that should the course of Mr. Holcomb be suddenly arrested, and the manufacture of these instruments cease in this country, their place could hardly be supplied by importation, at three times their present cost.

The four or five choice instruments made by Mr. Holcomb, have been the result of twice as many years of labour and perseverance, for which no adequate compensation can have been expected, except that satisfaction which every lover of science feels, in improving and extending the means by which it may be pursued.

The committee have little doubt that under proper auspices, and at an expense not exceeding that already encountered by some of our corporate institutions, in procuring instruments of little use, a twenty foot telescope might be made, which should do honour at once to the artist and the country.

By order of the committee.

March 11, 1836.

WILLIAM HAMILTON, *Actuary.*

*Mr. C. Wesener's manufacture of Artificial Soda.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, Mr. C. Wesener's manufacture of Artificial Soda, REPORT:—

That they have examined the various samples of artificial soda laid before them, and after a careful comparison of them with different specimens of Barilla, from Teneriffe and Sicily, are of opinion that these products may advantageously supply the place of the imported salts, for most purposes in the arts, as from a comparative trial made by means of the alkalimeter of Duscroizilles, it was satisfactorily shown that the proportion of soda in the several qualities manufactured by Mr. Wesener, rather exceeded that contained in natural barilla of about the same market price. There is, it should be stated, no novelty in the manufacture of this article, except that it is procured from the sulphate of soda, left as a residue in the making of nitric acid, from the native nitrate of soda from Peru, instead of from the same sulphate left after the extrication of muriatic acid from common salt; the artificial soda made from the last mentioned residue, almost always contains some chlorine, from which it is difficult to free it, whilst that made by the process of Mr. Wesener, is wholly free from this body.

The great consumption of the inferior qualities of soda, is by the soap makers, who are in the habit of using the natural barillas in preference to the artificial, from an idea that they are better and give out less sulphuretted hydrogen; the presence of this offensive gas, although of no consequence as regards the quality of the soap, is a serious evil where the manufacture of soap is carried on in a city, as is the case with most of our establishments of this kind. Mr. Wesener, has however, obviated this, by the preparation of an article which can be afforded at about the same price as natural barilla, and containing 62° of soda, which is entirely free from hydro sulphuric acid, and which hence can be employed by the soap boiler, without creating the nuisance usually attended on the lixiviation of the salts used by him.

By order of the committee.

May 12, 1836.

WILLIAM HAMILTON, *Actuary.*

*Report on Mr. Charles Potts's Pumps for Steam Engines.*

The Committee on Science and the Arts, constituted by the Franklin Institute the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Pump for Steam Engines, invented by Mr. Charles Potts, of Philadelphia, REPORT:—

That the inventor proposes (for the purpose of supplying the water to steam boilers) to employ, in lieu of the ordinary forcing pump, a contrivance by which the water runs into the boiler by its own gravity. It consists of a chamber, or cavity, connected with the boiler below, and a tank or reservoir above it, and communicating with them alternately, first filling with water from the tank and then emptying it into the boiler, into which it passes by its own gravity in exchange for an equal bulk of steam.

In regard to the important question of novelty, the committee have to state that the proposed plan is familiar to them, but it is considered to be of doubtful utility, as the chamber must be below the temperature of boiling water at the time of filling, and again raised, at least in part, to that of the

steam in the boiler, before it can be made to descend into the boiler. They consider, however, that the apparatus is worthy of a renewed trial.

By order of the committee,  
May 12, 1836.

WILLIAM HAMILTON, *Actuary*.

## Mechanics' Register.

### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JANUARY, 1836.

*With Remarks and Exemphfications by the Editor.*

1. For *Water proof Silk Plush Hats*; George Blake Dexter, Boston, Massachusetts, January 6.

This patent is taken for what is deemed an improvement in the manipulation of applying the silk plush to the body of the hat, after it has received the ordinary coating of dissolved caoutchouc, by which it is made to adhere; the process consists mainly, in passing a metallic cylinder over the plush so as to press it against the body of the hat, and cause it to adhere to it. This cylinder is, we apprehend, formed by bending a metallic plate so that its ends shall nearly meet, and around this a band of India rubber is to be placed, which by its elasticity, is to keep the metal in close contact with the crown. The description is not very clear, but such is our understanding of the thing. The claim is to "the improvement in the application of plush or any other fabric to the body of the hat, by means of a bent metal plate, and by an operation as above described."

2. For an *Elastic revolving belt Saw*; Benjamin Barker, Ellsworth, Hancock county, Maine, January 6.

The patentee says, "what I claim as my invention, and not previously known in the above described machine is, the elastic revolving belt saw, and the manner of using the same. I do not therefore, claim as my invention any of the other several parts of said machine, nor their particular combination." If the patentee could have made any new arrangement of the parts for operating this saw, he might have claimed such arrangement with some propriety, but the saw itself which he does claim is quite an old affair; it is mentioned in Rees' Cyclopædia; has previously been patented more than once in the United States; has been repeatedly tried, and as frequently abandoned as worthless in operation; and such will again be its fate, should it again be essayed by the present patentee.

3. For a *Forest, or Tree Saw*; Walter Hunt, city of New York, January 6.

Considerable ingenuity has been displayed in the arrangement of the apparatus described and figured by the patentee, who has made his invention fully known. The apparatus consists of a *grapple* by which the whole is to be attached to the tree to be felled, by means of a screw, spike, &c.; the *lever*, to which one end of the saw is to be attached, and which, by being moved backward and forward horizontally, operates on the saw; the *saw* and a *spiral spring*, by which the latter is to be kept up to its cutting bearing.

The particular construction of these parts we shall not attempt to describe. The patentee claims "the style of construction, combination, and arrangement of the *forest tree saw*, as above specified, &c." We shall not, as we have said, attempt a particular description of the proposed arrangement of the parts of this machine, but predict that it will share the fate of other saw machines for felling trees, and be found by far less efficient than the axe of the woodman. We apprehend that the patentee has not had much experience in clearing land, or he would have known that his wedges and other contrivances would not enable him to determine the direction in which his tree should fall, and that the experienced axeman is sometimes at a fault in this particular, an event which would be fatal to the whole apparatus before us.

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4. For *Separating foreign seeds from Clover Seed*; James Manning, Lambertsville, Hunterdon county, New Jersey, January 6.

A screen, or riddle, is to be made in the form of a flour bolt, or otherwise, and this is to be covered with wove wire, the meshes of which are oblong, and a little narrower than the diameter of the clover seed; the claim is to the "making these apertures of an oblong figure." This patent will take rank with those which are the least worthy of an exclusive right, for however good such a screen, sieve, or riddle, may be, it has been so common as to render the idea of claiming it as a novelty truly ridiculous.

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5. For a *Washing Machine*; Joab H. Hubbard, Bloomfield, Harford county, Connecticut, January 6.

By this machine the clothes are to be "pounded" in a box, upon the bottom of which there are pins projecting upwards; the pounders, two in number, having pins on their lower sides which pass into the spaces between those within the box. The pounders have each a rod extending up from them through the lid of the box, and these being operated upon by cams and springs, are raised by the former and forced down by the latter. A horizontal shaft carrying a cog wheel, and turned by a winch, causes a second shaft, having a pinion on it, to revolve, this latter, carrying the cams, or lifters—rather a complicated child of ingenuity this, and one, which we opine, will not find many foster mothers.

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6. For a *Machine for cutting Wooden Screws*; Joseph Peavy, Levant, Penobscot county, Maine, January 6.

This machine for cutting male and female screws upon wood, differs so little from others which have been used for that purpose in large manufactories, as not to require any particular description. The V is fixed upon a sliding frame, the piece to be cut being contained in another frame, in which it is made to revolve by turning the guide screw, which at the same time forces the V frame forward. A similar apparatus, with a suitable cutter, is used for the female screw.

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7. For *Dyeing and colouring Hats*; Aaron Gould, Washington, Litchfield county, Connecticut, January 6.

The hats are to be put into a basket, or crib, and this placed in the dye kettle, and taken out for airing in any way that may be preferred, until the colour becomes perfect. This is all, but is it new?

8. For an improvement in *Locks for Doors*; Solomon Andrews, city of Perth Amboy, New Jersey, January 11.

In this lock, which is intended chiefly for large doors, the cam part of the key consists of several pieces which are passed on to the shank, and being of different lengths, may be variously combined, thus admitting of numerous changes by corresponding changes in the tumblers upon which the cams of the key are to operate.

There are eight distinct claims made to the different parts of this lock, which, however, would not be understood, if given without the drawings and description. In the general mode of combination and action by means of movable cams and tumblers, it bears considerable resemblance to the lock patented by Mr. Kyle, described in vol. 10, p. 331.

9. For a *Mill for cutting Grain and other articles*; William Gerish, Portsmouth, New Hampshire, January 11.

Two iron plates from six to eighteen inches in diameter, constitute the cutting, or grinding, part of this mill. The under plate is to be the runner and to be driven by any proper gearing; both plates are to be slightly conical. The upper plate is to have several perforations in it, which are to receive cutting irons, fixed and operating in the manner of plane irons. Besides these cutters there are ridges, or teeth upon the grinding faces. The claim is to "the cutters and cavities, their particular arrangements and principle, applied to this purpose."

10. For *Building Wharves, Piers, &c.*; John G. Pray, Brooklin, King's county, N. York, January 11.

The building of wharves, piers, and breakwaters, is treated in this specification, as a very simple and easy affair, but it certainly is not rendered so by the clearness of the description, or by any references to the drawing; the former being extremely general in its terms, and the latter, although well enough executed, showing a wharf in its finished state, and without any references whatever; nor is there any claim made to any part of the invention.

After the foundation has been laid, "which is done with the greatest ease, blocks, piers, or pillars of any dimensions, may be raised thereon in the following manner," &c. &c. We are to take blocks of stone, or of cast-iron, eight or ten feet long, and one or two feet square, and provide two of them with a *conductor* at each end, one or two inches in diameter, so placed that when the stone is laid for the foundations, the conductors will rise above the water, down these the stones, or blocks of iron are to be slid, they being, we suppose, drilled with holes through them for that purpose. The stones, &c. are to be piled up in this way, the second laying transversely upon the first. The ends having been prepared so that they will come together in a dovetail. When raised to a sufficient height they are to be arched over. We think any thing further unnecessary, the foregoing being a fair example of the mode of description adopted in this specification.

11. For *Dressing and Napping Cloth*; Stephen Marsh, Jerico, Chittenden county, Vermont January 11.

This machine in its general construction, resembles those now in common use for the napping of cloth, but the patentee thinks that considerable advantage is derived from causing the card teeth on the napping cylinder to

stand in the direction of radii, or nearly so, from its centre. "Said Stephen Marsh, claims as his invention, the direction of the card teeth, radiating in direct lines from the centre, or axis of the cylinder, or having a less inclination than those which are now, or heretofore have been, in use. Also the passing the pivot of one wheel through the axis of rotation of the other, and the general arrangement and combination of the machinery as set forth." We doubt the validity of the claim to the radiating, or nearly radiating, teeth, as we believe that they have been frequently so employed. The other point claimed is a mere matter of arrangement, not at all necessary to the action of the machine.

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12. For a *Machine for Drilling Wood, Metal and Stone*; William Roy Jones, Granville, Washington county, New York, January 11.

If this be an improvement in the mode of drilling and boring, we should prefer some unimproved machinery that we have seen in use. A frame is made, having a bed upon which to place the frame to be drilled or bored; the drill is fixed in the lower end of a vertical shaft, or mandrel, which is to be turned by a winch on its upper end. The mandrel passes through the centre of a wooden, or metallic, screw, turning in a nut in the upper part of the frame, which screw is to be forced down by a handle on its upper end, just below the above named winch. The claims "are to the crank (winch) on the end of the screw passing through the nut, and the screw pressing on the shoulder of the mandrel."

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13. For *Hanging Carriages by means of tubes and spiral springs*; Henry Mellish, Walpole, Cheshire county, New Hampshire, January 11.

"The invention here claimed is the combined application of the springs and tubes to the above named purpose." The contrivance consists simply of a spiral spring of wire enclosed in a tube, with such appendages as are necessary to attach it to the carriage, and to cause the weight of the body to rest upon the springs. There is no novelty whatever in the employment of spiral springs, contained within tubes, for hanging carriage bodies, but they have been found so much less to be depended upon than springs of the more ordinary kind, that they have uniformly, after trial, been thrown aside.

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14. For a *Machine for Planting Corn*; Charles R. Belt, Washington county, District of Columbia, January 15.

There are many patented machines for planting corn, cotton, and other seeds, so nearly resembling each other, as to constitute different modifications only of the same machine, and such is the character of the one before us. The claims made are confined to two particular points in which the patentee considers his machine as excelling its predecessors, but its superiority not being apparent to us, we shall pass on to other matters.

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15. For a *Plough*; John Dolhaner, Canton, Stark county, Ohio, January 15.

There is nothing claimed as new in this plough, but the mode in which the parts are fastened together, so as to give it the desired stability.

16. For an improvement in the *Construction of Bedsteads*; Jonas Maguire, city of Philadelphia, January 15.

Dowells are to be put into the ends of the rails instead of cutting tenons thereon, and corresponding holes are to be bored into the posts to receive the ends of these pins, or dowels; screws are to be used for fastenings, in the usual way.

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17. For *securing Wells from the influx of Surface Water*; Levi Kidder, city of New York, January 15.

"The principle of this improvement consists in the construction of hydraulic cement, of a protecting cover and sides to wells, cisterns, reservoirs, and other vessels in the earth, whereby the water within them will be secured against the influx of surface water, and the intrusion of vermin in the mode and by the means substantially as described."

The mode described is to raise a wall of cement upon the ordinary wall of the well, to cover this with a top in the form of a dome, leaving an opening in the middle for the pump body.

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18. For the application of hydraulic cement to making *Covers for Wells, &c.*; Livi Kidder, city of New York, January 15.

This patent is taken for covers pretty much like those above described; that is to say, a cover for wells, cisterns, &c. is to be made in the form of a dome, leaving a suitable opening for a man to pass through, or for other purposes; it appears, however, that the design is to secure the particular mode of forming such covers, which is as follows:

A mound of earth is made in the shape of the inside of the cover, and upon this mound the cement is to be cast, or spread, to the thickness of four inches, more or less. When the cover is large, it is to be divided into sections of a convenient size for removal. "The improvement which this applicant claims to have invented, consists in making said covers, not upon the well, cistern, or other vessel, where they are to be used, but in a shop or suitable manufactory in which they can have time to season, and from which they can afterwards be removed to the place of use."

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19. For a *Machine for pressing Tobacco in*; J. Beverly Allen, city of Richmond, Virginia, January 15.

This machine for pressing tobacco in, is merely a square box, four of the sides of which are of tin, the other two being of wood. The patentee says that "before this box was invented the manufacturers of pressed tobacco were compelled to use oaken boxes, the material for constructing which has recently become very costly, and difficult to be obtained. What I claim as my invention, and not previously known, in the above described machine, is the use of tin for four sides thereof, instead of wood, which was before exclusively used."

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20. For an improvement in the *Machinery for forming and hardening Ropes, of any required length*; John Whiteman, city of Philadelphia, January 15. (See Specification.)

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21. For an improvement in *Trunks, Valises, &c.*; James W. Noble, Pittsfield, Berkshire county, Massachusetts, January 15.

There is not any thing furnished by the patentee which amounts to a de-

scription of his mode of making trunks, valises, &c.; we gather, however, from what is said, that there is to be a frame, to which the leather used, is to be attached by means of rivets, without the use of sewing, or of tacks. The frame, we suppose, must be of iron, perforated so as to receive the rivets; but even this is matter of conjecture; yet, if the story told be correct, the improvement is worthy of a good specification, as we are informed that this trunk, &c. will possess great strength, and compactness, require less leather than ordinary in the construction, and produce a saving of seven-eighths of the time ordinarily consumed in the manufacturing of such articles.

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22. For a *Plough*; Samuel Witheron, Gettysburg, Adams county, Pennsylvania, January 15.

The whole description is as follows: "The improvement consists in placing a roller under the beam, near the centre of the plough, in or near a perpendicular position; the roller may be made plain, ridged, grooved, or otherwise. The use of the roller is to prevent the plough from choaking, by rolling off the vegetable matter that usually collects under the beam."

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23. For an *Art, or method, or process, of lessening the consumption, and of increasing and otherwise improving the effects of fuel*; Isaac Orr, Washington, District of Columbia, January 20.

It is not easy from the title, to tell for what this patent has been obtained; whether for a stove of a particular construction, or for the art of managing the fuel. The claims, however, fifteen in number, relate principally to matters of construction, but in a way so general and diffusive, as not by any means to enable us to distinguish those things which are intended to be the subject of the patent "from all other things before known or used," as required by the act of Congress. The principal feature in the stove which the patentee denominates the *air-tight stove*, is the so constructing, or making, the sliding or other doors which open into the stove, that when closed they shall be, as nearly as may be, air-tight, by which means the combustion of the contained fuel, may be completely controlled, and but little, or no, consumption take place, whatever may be the quantity within the stove. That such a stove cannot, and must not, be made perfectly air-tight, will be at once admitted, and we are not aware at what degree of good fitting, the affair would be entitled to a patent. We have a stove in which the design was to make the doors, and the ash drawer, fit as closely as possible, so that the fire might be regulated by the drawing out, or closing, of the latter; this is one of Spoor's, and there are many others similarly constructed in this respect, and in which, were the workmanship made a little more perfect, without any change of structure, all that Mr. Orr proposes from this arrangement would be accomplished.

In addition to the close doors, the patentee has grate bars placed under the fuel, resembling the revolving vertical dampers, or valves, used in some stoves, and consisting of two plates with openings, which may be made to coincide, or which may be closed by the unperforated parts. If we do not greatly err, such a grate will be obstructed by the coal, and choaked by the ashes. There may be enough in some of the individual arrangements pointed out, upon which to found and sustain a claim, but they are not made to stand alone, and it is not in our power to put them in a situation to do so.

24. For a *Portable Reflecting Baker*; Lorenzo B. Olmstead, Binghamton, Broome county, New York, January 20.

This tin baker is to be heated by means of a cylinder of sheet-iron, which is to contain ignited charcoal, and to pass vertically down through the back of the box which constitutes the baker. This latter is a kind of eight sided oven, the top being ridged like a roof, and the bottom in the same form inverted, the back circular, and the front, which lifts off, being straight; we mention these things because the peculiar form is claimed. The articles to be baked are put into pans, which stand on wires within the baker, and the fire being kindled, and the front reflector affixed in its place, we are assured that the desired operation will be "performed sooner than in any known oven or baker, with an immense saving of fuel."

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25. For *Cutting grooves in Corset rings of Bone, Ivory, &c., and also in other articles*; Charles Buckland, Middletown, Middlesex county, Connecticut, January 20.

The ring to be cut is placed upon the projecting end of a revolving mandrel, the frame of which is made to slide so that the ring may be brought up against a revolving saw, or cutter, which cuts the groove. The appendages for adapting it to the purpose to which it is applied, are represented and described, and the combination of the several parts constitutes the claim.

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26. For a *Thrashing Machine*; Eleazer Brown, Chenango, Broome county, New York, January 20.

This thrashing machine consists of a hollow cylinder about three feet in diameter; its length is not mentioned, but from the drawing, we should suppose it to be, at least, twelve feet. It stands horizontally in a frame, and within it revolves a shaft, which carries four, or any other number of rows of wooden beaters. The grain is fed into the cylinder through an opening in its side, near to one end, which is closed, the other being left open. On the shaft near the closed end are spiral fan leaves, which force a current of air through the cylinder. The patentee says that "the rapid motion of the shaft separates the grain, and the strong current of air driven through the cylinder by the fans, carries out the straw and grain." There is no claim made, the general construction being probably considered as new, which we believe it is.

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27. For a *Horse Power*; Samuel Newton, Dayton, Montgomery county, Ohio, January 20.

This horse power is one of that kind which receives its impulse from the walking of the horse, or other animal, upon an inclined floor forming a chain of slats, the patentee calls it the "Friction Obviator, or Double Chain Horse Power," in which is combined the joint application of two continuous, or endless, chains. The second of these endless chains consists of rollers connected by suitable straps, which sustain the movable floor by running upon a suitable railway under it, the part not so employed hanging down beneath the floor. After a full description of the apparatus a claim is made to "the particular manner of constructing the friction chain," &c. We could refer to several patents taken in the United States, for a perfectly similar contrivance, but will go farther back than any of these, and look in the second volume of the first series of the Repertory of Arts, p. 366,

where we find the same machine described and figured, having been patented in England, in January, 1795.

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28. For *Propelling Boats*; Philander Noble, Westfield, Hampden county, Massachusetts, January 20.

The patentee is, we apprehend, either a clock or watch maker, and knows very well that a spiral spring contained in a barrel, and made to act upon a fusee by means of a chain, is a sufficient maintaining power for his time keepers, and, by parity of reasoning, he concludes that it will answer equally well for boats. "This invention or improvement, consists in the application of the machinery of a clock to the purpose contemplated." The springs, we are informed, are to be wound up in the usual way; by means of the finger and thumb, we suppose. The plan is too absurd to reason about, and too contemptible even for ridicule.

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29. For a *Plough*; John P. Chandler and Peter Ranger, Wilton, Kennebec, Maine, January 20.

We have, for brevity's sake, called this a plough, but the patentees denominate it a "Machine for ploughing land," and indeed from its complexity it appears to require some such appellation. It has an axletree and two wheels, like a cart, with a frame somewhat like that of a cart body, sustaining a tongue to which to attach the horses, together with other appendages. Under this frame there are to be three ploughs abreast, all of which are to be managed, by means of levers and suspending chains, by a person seated on the machine; the ploughs being so suspended that they can be raised or lowered at pleasure. The claim made is to "the using of two or more ploughs at the same time, and with the same team; and also having the plough suspended so as to have the weight of it carried on wheels." The patentees might, probably, sustain a claim to their own mode of doing these things, but double ploughs have often been used, and wheeled ploughs are represented in the books, and are common in Europe.

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30. For an improvement in *Saddles and Horse Collars*; Ebenezer Hale, city of New York, January 20. (See Specification.)

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31. For a *Corn Sheller*; Warren Carpenter, New Castle, Mercer county, Pennsylvania, January 23.

A plank is to be slid up and down between two cheeks, grooved for that purpose; into each side of this plank iron pins are driven, which project out a short distance. The corn to be shelled is to be dropped in between this slide, and two pieces of plank near the lower end of the frame, which are borne up towards the slides by springs; these spring pieces of plank are armed with teeth, like the slide. The slide is to be worked up and down by hand. The claim made is to "the particular structure, combination and arrangement of the respective parts."

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32. For a *Forcing Pump*; Benjamin Egbert, Lansing, Tompkins county, New York, January 23.

There is about as little to patent in this pump, as in most of those which obtain that nominal sanction. The claims made are to things either old, or worthless, and the whole construction is as far from meriting the name of an improvement, as can well be imagined. The claims made are to "the

base plate, the forked tube, the side rods, the cap piece, and the waste tubes, together with the mode of fastening the pump by the platform to the sink." The patentee might with about equal propriety claim his shoes, his two arms, his legs, his fur-cap, and his facial protuberance, together with the mode in which he seats himself at the table.

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33. For a *Cast metallic Funnel, to be used on Stove Pipes*; Ezra Ripley, city of Albany, New York, January 23.

Ferules are to be cast which pass into, or receive the ends of the pipe to be joined. These ferules are to be made ornamental, and there is a contrivance for attaching them to the pipe, by means of a wire, so as to keep them together. These ferules, the patentee says, "improve the beauty, increase the heat, and add strength and security."

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34. For an *Expanding Sulky Seat*; Orion H. Capron and Gardner Barton, Jr., Shaftsbury, Bennington county, Vermont, January 23.

The body of the sulky is to be made so that the seat and back shall consist of slats, or rods, which may slide between each other, so that it may lengthen out and accommodate two persons. The cushions must, of course, be made so as to double when the vehicle is in the sulky mood. The construction of the affair is described, but the mode of procedure is not claimed.

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35. For a *Machine for Packing Flour in Barrels*; Jonathan F. Barrett, Granville, Washington county, New York, January 23.

This is certainly a new, and, we think, a good machine. The flour to be pressed, runs into the barrel in a continuous stream, and the pressing commences at the bottom, and goes on until the barrel is filled. The barrel is placed on the bed of the press, and above it there is a vertical shaft, which is made to revolve by a drum and band, and is capable of rising and falling through the height of the barrel. At the lower end of this shaft there is what is called a screw, but this essential part is very imperfectly described; it is nearly of the diameter of the interior of the barrel, and appears to be a transverse section, containing a single thread of a screw, and it has, of course, an opening from its upper to its lower side, through which flour may pass. The shaft, we suppose, must revolve in a direction tending to raise this section of a screw, and the bottom of it, forming a spiral inclined plane, presses upon the flour as it passes through the opening, having to operate upon thin successive strata only, and thus gradually rising to the top, when the packing is completed. The shaft is loaded with any amount of weight which may be found necessary, and there is appended to it the apparatus necessary for raising and lowering the shaft rapidly, when requisite. The claim made is to the employment of "a screw on the end of a weighted shaft," in the manner described.

The patentee says that about three minutes completes the pressing of a barrel of flour; the manual labour, however, not exceeding five seconds; that during the operation there is not any bursting of hoops, or pressing of flour out of the sides; that with a machine made to test the improvement, one man can readily pack, weigh, and nail off, about twenty barrels per hour.

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36. For an improvement in the *Construction of Wooden Bridges*; Stephen H. Long, Lieut. Col. U. S. Topographical Engineer Corps, January 23.

"The improvements claimed as new and useful consist in the application

and use of lattice, work, in the manner and of the description herein explained, for the purpose of imparting the requisite lateral stiffness to wooden bridges, in a manner more simple, economical and efficient than the means heretofore employed for that purpose; it being understood that *lateral* and *horizontal* stiffness, in contradistinction from *vertical* and *transverse* flexibility, is the object of this invention."

This diagonal lattice-work framing, to be applied to the upper, or the lower, string pieces of bridges, is similar to the lattice-work truss frame, forming the sides of Town's bridges.

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37. For an improvement in the *Garden Hoe*; Adna Allen, Ramapo, Rockland county, New York, January 23.

This patent is taken for the manner of attaching the shank to the plate of the hoe, so as to render it secure from working loose. The plate or blade of the hoe, is perforated with a square hole; the shank is made to fit this hole, and has a collar formed on it which comes up against the plate; a second plate, like a washer, passes over the shank on the face of the hoe, and the whole is secured together by riveting; the shank is secured in the handle by a ferule, and fastened by a key driven through both. The claim is to "the collared shank, back plate, and rivets, viz: the collar on the shank, and the principle of attaching the back plate to the plate of the hoe."

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38. For a *Trap for Rats and other Animals*; Thomas Neil, Kirkersville, Licking county, Ohio, January 23.

This trap is so much like some others, that the claim to "the before described machine" appears to us to be a claim to that which had been made, if not described, long before. The trap is a long box, with a fall at each end, held up by a trigger very much like other triggers. In the centre of the box are placed two pieces of looking glass, to invite tenants to enter; an old and well known device.

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39. For *Constructing Coffins of Hydraulic Cement*; John White, Syracuse, Onondaga county, New York, January 23.

"The patentee says, "all that I claim under the foregoing specification, and wish to secure by letters patent, is the right of employing any hydraulic cements, materials, or mortars, not included in the before mentioned patents, in the making of receptacles for the dead; constructing the same in any form or shape which may be deemed convenient or desirable."

The "before mentioned patents" above referred to, are that granted Dayton, Hoyt, and White, on the 6th of June, 1835, and that to John White alone, on the 25th of July, 1835.

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40. For an improvement in the *Horse Collar*; John Hopkinson, Hamilton, Warren county, Ohio, January 23.

The specification tells how to make a pattern by which to cut the leather, how to soak it and to tack it on to a cramping board, how to sew the parts together, and concludes by giving advice to stuff it, make the pad, and finish it off in the usual way; but it says nothing about a claim. There is a drawing, from which we cannot learn any thing, excepting that it represents a well looking horse collar.

## SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a patent for an improvement in the manner of constructing Saddles and Horse Collars. Granted to EBENEZER HALE, City of New York, January 20th, 1836.*

To all whom it may concern, be it known, that I, Ebenezer Hale, of the city, county and state of New York, have invented a new and useful improvement in the manner of constructing saddles and horse collars, in which I substitute that perfectly elastic article, air, as a stuffing, for the comparatively rigid and non-elastic materials heretofore employed, and I do hereby declare that the following is a full and exact description thereof.

The object in view is to interpose air between the hard materials, which form the foundation or more solid parts of saddles and horse collars, and those parts of them which bear upon the animal. In the general form or manner of making these articles, I do not profess to have made any improvement; all that I propose to do being merely to omit the ordinary stuffing on the bearing parts, and to cover them with leather, cloth, or other material rendered impervious to air by means of India rubber, or otherwise; so forming and fixing such covering as that when inflated, by means of a condensing syringe, the bearing parts will become distended, and assume the intended form. In some suitable part of the articles an opening furnished with a valve must be made for the purpose of attaching the syringe.

The manner in which the air-tight covering is to be attached, does not admit of, or require, any particular description, as it may be varied in numerous ways, and must be left to the judgment and fancy of the workman, who, if skilful, will be at no loss in this particular.

What I claim as my invention, is merely the substitution of air for other materials in forming a stuffing for the bearing parts of saddles and horse-collars.

EBENEZER HALE.

*Specification of a patent for an improvement in the machinery for forming and hardening Rope. Granted to JOHN WHITEMAN, city of Philadelphia, January 15th, 1836.*

To all whom it may concern, be it known, that I, John Whiteman, of the city of Philadelphia, in the state of Pennsylvania, have made an improvement in the machinery for manufacturing rope, by which it may be made of any desired length in a manner more convenient than any which has heretofore been practised; and I do hereby declare that the following is a full and exact description thereof.

A shaft or spindle is to be made to revolve horizontally, in a frame of suitable dimensions, its size depending upon the nature of the work to be performed by it. This shaft runs in boxes, bearings, or collars at each end. The front end where the spinning is performed, is made hollow in the manner of the spindle of the small flax wheel, admitting the rope which is to be twisted, to pass through it in the same way. In the eye or opening thus made, at the back of the bearing of the shaft, there is a small friction pulley inserted, to enable the rope to pass readily through the perforation in the spindle. There is a reel upon the spindle, upon which reel the rope is to be wound as it is made ready therefor. This reel is so constructed as to be capable of being thrown into and out of gear, with perfect facility; this may

be effected by means of a feather on the shaft, which is received in a notch made for the purpose, in the head of the reel. The throwing out of gear is done whenever the rope is to be wound upon the reel, which when disengaged from the feather, by being slid back, engages by means of suitable stops or projections, with a wheel and pinion, furnished with a winch, by which the reel may be turned back, and the rope wound upon it.

In order to wind the rope upon the reel I employ a sliding bar, having upon it teeth, forming it into a rack, into which teeth a pinion engages, by which the rack can be moved backwards and forwards. This sliding bar is placed on one side of the frame, parallel to the shaft, and extends from front to back of the machine; its motion is governed by suitable slides. The pinion by which it is moved is placed upon the vertical shaft at the back end of the machine, where it also bears against a friction roller acting on its smooth side. There is a fixed snatch block upon the front post of the machine, and a second snatch block on the inside of the slide towards the spindle, and when the rope is to be wound upon the reel it is first passed round the pulleys of these blocks, when the reel may be turned back, and the rope distributed upon the reel by means of the rack and pinion. For a more perfect understanding of the arrangement of the apparatus by which this is effected, I refer to the drawing, with written references thereto, deposited in the patent office in conformity with the requirements of the law in that case made and provided.

Although I have in the foregoing description spoken of using one spindle only, it is to be distinctly understood that I intend to combine three, or any other number which I may prefer of such spindles, constructed and operating upon the same principle, in the same machine.

What I claim as my invention in the machinery for making ropes and cordage is the manner of distributing the rope, as within described, upon a reel placed upon a shaft or spindle, driven by any of the ordinary means of giving motion to shafts for spinning; which reel is so constructed as to engage and disengage in the manner, and for the purposes herein set forth, whether the same be applied to only one, or to a greater number of spindles in the same frame.

JOHN WHITEMAN.

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## Progress of Physical Science.

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### *Dissected Battery and Standard Battery of Professor Daniel.*

For the purpose of ascertaining the influence exerted by the different parts of the voltaic battery, in their various forms of combination, Professor Daniel, contrived an apparatus, which he designates by the name of *the dissected battery*, and which consists of ten cylindrical glass cells, capable of holding the fluid electrolytes, in which two plates of metal are immersed; each plate communicating below, by means of a separate wire, which is made to perforate a glass stopper closing the bottom of the cell, with a small quantity of mercury, contained in a separate cup underneath the stopper, and with which electric communications may be made at pleasure through other wires passing out of the vessel on each side.\*

\* The arrangement seems to us much inferior in convenience, to the battery devised for similar objects, by Professor Henry of Princeton, and described in the *Amer. Philos. Trans.* Vol. 5, Part 2.

A series of experiments performed with the dissected battery is next described; illustrating, in a striking manner, the difference of effects with relation to the quantity and the intensity of the electric current, consequent on the different modes of connecting the elements of the battery: the former property being chiefly exhibited when the plates of the respective metals are united together so as to constitute a single pair; and the latter being exalted when the separate pairs are combined in alternate series. The influence of different modifications of these arrangements, and the effects of the interposition of pairs in the reverse order, operating as causes of retardation, are next inquired into.

In the course of these researches, the author, being struck with the great extent of negative metallic surface over which the deoxidating influence of the positive metal appeared to manifest itself, as is shown more especially in the cases where a large sheet of copper is protected from corrosion by a piece of zinc or iron of comparatively very small dimensions, was induced to institute a more careful examination of the circumstances attending this class of phenomena; and was thus led to discover the cause of the variations and the progressive decline of the power of the ordinary voltaic battery, one of the principal of which is the deposit of the zinc on the platina [or copper] plates; and to establish certain principles from which a method of counteracting this evil may be derived. The particular construction which he devised for the attainment of this object, and which he denominates the *constant battery*, consists of a hollow copper cylinder, containing within it a membranous tube formed by the gullet of an ox, in the axis of which is placed a cylindrical rod of zinc. The dilute acid is poured into the membranous tube from above by means of a funnel, and passes off, as occasion requires, by a siphon tube at the lower part; while the space between the tube and the sides of the copper cylinder is filled with a solution of sulphate of copper, which is preserved in a state of saturation by a quantity of this substance suspended in it by a collander, allowing it to percolate in proportion as it is dissolved. Two principal objects are accomplished by this arrangement; first, the removal out of the circuit of the oxide of zinc, the deposit of which is so injurious to the continuance of the effect of the common battery; and, secondly, the absorption of the hydrogen evolved upon the surface of the copper, without the precipitation of any substance which would tend to counteract the voltaic action of that surface. The first is completely effected by the suspension of the zinc rod in the interior membranous cell, into which the fresh acidulated water is allowed slowly to drop, in proportion as the heavier solution of the oxide of zinc is withdrawn from the bottom of the cell by the siphon tube. The second object is attained by charging the exterior space surrounding the membrane with a saturated solution of sulphate of copper, instead of diluted acid; for, on completing the circuit, the electric current passes freely through this solution, and no hydrogen makes its appearance upon the conducting plate, but a beautiful pink coating of pure copper is precipitated upon it, and thus perpetually renews its surface.

When the whole battery is properly arranged and charged in this manner, it produces a perfectly equal and steady current of electricity for many hours together. It possesses also the further advantages of enabling us to get rid of all local action by the facility it affords of applying amalgamated zinc; of allowing the replacement of the zinc rods at a very trifling expense; of securing the total absence of any wear of the copper; of requiring no employment of nitric acid, but substituting in its stead materials

of greater cheapness, namely, sulphate of copper, and oil of vitriol; the total absence of any annoying fumes; and lastly, the facility and perfection with which all metallic communications may be made and their arrangements varied. Abstract of Proceedings Royal Soc. in Lond. and Edin. Phil. Mag., May.

*On the general Magnetic relations and characters of the Metals.* By Professor FARADAY.

In a paper in the number of the London and Edinburgh Philos. Mag. for March, Prof. Faraday has a paper bearing the title just quoted. He states that general views had long since led him to the opinion, that all the metals are magnetic, in the same manner as iron, though not at common temperatures; iron and nickel being no more exceptions to the magnetic relations of metals in general, than mercury is in their relations to heat. He reduced the temperatures of the following metals to 60 or 70° below zero of Fahrenheit's scale, by the evaporation of sulphurous acid, but could perceive no indications of the development of magnetism in them. Arsenic, antimony, bismuth, cadmium, chromium, cobalt, copper, gold, lead, mercury, palladium, platinum, silver, tin, zinc. Plumbago was subjected to the same result. Prof. Faraday also investigated the temperature at which nickel loses its power of becoming magnetic, with a view to compare it with the corresponding point, for iron which is worked at an orange heat. This point was found to be, for nickel, between 630 and 640° Fah. Steel loses its permanent magnetic power suddenly below the boiling point of almond oil; between this temperature and an orange heat it acts as soft iron. The temperature at which polarity was destroyed, appeared to vary with the hardness and condition of the steel. A natural magnet, or loadstone, retained its polarity at a temperature above that at which steel lost the same power, losing it when visibly red in the dark. On the contrary, the same loadstone lost the action similar to soft iron, of becoming magnetic by induction, at a lower temperature than steel. The same results were found when the loadstone of which the magnetism had been destroyed by heat, had its polarity destroyed on cooling, by touching with an artificial magnet. Abstract from Lond. and Ed. Philos. Mag.

*Ice formed at or near the bottom of Streams.*

The formation of ice in such situations is thus explained by M. ARAGO.\*  
—1st. The circumstance already adverted to, that in streams the rapidity of the current, especially in falls, carries down the colder water of the surface, and mixes it with that at the bottom; so that the deepest part here is colder than in still water.

2d. The rough and pointed nature of the substances at the bottom favour the deposition of ice, in the same manner as similar asperities form the nuclei for crystalization in solutions of salts.

3d. The motion of the stream near the bottom is retarded by friction; thus there is less impediment to the formation of the spiculæ of ice.

Mr. Farquharson, in a recent investigation of this subject,† admits that these causes are all in action, but denies their *sufficiency* to account for the entire phenomena.

He assumes the cause to be, that *heat radiates through water*; that the same laws prevail with respect to the influence of the state of the *surface* in promoting radiation, in water as in air. Consequently, the *rough surface*

\* *Annuaire des bureau des Long.* &c. 1833. † *Royal Soc. Trans.* 1835, Part I.

of the stones, gravel, &c., at the bottom, enables them to radiate heat, and cool fastest, and there the ground-gru forms.

A writer in a recent number of the London Magazine of Popular Science, after showing the contrariety of the fact assumed by Mr. Farquharson, with the experiments of Melloni, offers the following suggestions:

"There is another distinctive circumstance not adverted to either by Mr. Farquharson or other inquirers, but which appears to us the most efficacious of all others to the production of the phenomena. The adjacent ground, and the bed of the river, are first cooled down by a frost to a lower degree than the water; and thus the bottom will be rather colder than the incumbent strata of water, even in the rapids, where it is soonest brought to an equilibrium of temperature; and this cooling down of the whole adjacent ground, of course, goes on most rapidly under a clear sky, by radiation at night; the ground in the bed of the river acquiring the same temperature, or nearly so, by lateral conduction.

Now solid rock is a much better *conductor* of heat than loose gravel, or sand, &c., and the former, it appears, composes the bed of the rapids, the latter of the pools. The former, therefore, conducts quickly away the slight excess of temperature in the running water of the rapids, and converts it into ground-gru. The latter conducts more slowly, and has also a greater degree of temperature to carry off; thus—the gru does not form.

*Height of Waves.* A writer in the Nautical Magazine (Eng.) concludes from his observation of waves after a storm in the Atlantic, that the total height was not less than fifty feet, since "a horizontal line drawn from the apex of the loftiest wave to the ship, would have intersected the main mast about half way from the deck." He gives, further, an estimate founded on the observation which follows:

"A large ship, which was for a short time in company with a frigate we were on board of, was lost sight of at intervals when she fell into the trough of the sea, and only entirely visible when both vessels happened to be on the ridge of the respective waves which bore them up: this alternation of appearance and disappearance continued until we had approached within less than a mile of the ship, for at about that distance, when one enormous wave intervened, she was hid for the last time during the approach. Her elevation from the water-line to her mast-head could not have been less than ninety feet. When both ships were depressed, they were invisible to each other; and when one was on the ridge of a wave, and the other in the trough, part of the masts of the latter were visible to the former.

The distance between the ships, and the relative proportions of the objects, should be kept in mind:—a ship compared to one of those billows would be as a mere speck, allowing the breadth of the wave to be half a nautical mile, or 3040 feet; and if we admit the wave to be only twenty feet, the ship's hull thirteen, and five for the height of the observer, the eye, when the ship was on the ridge of the wave, would be elevated thirty-eight feet above the trough in which the other was situated."

*Steel for Magnets.* Mr. R. Knight concludes that open-grained blistered steel is well fitted for powerful magnets; that closing the grain by heating and hammering it, though it should still remain carbonised, greatly injures it, and that the subsequent action of heat, in opening it, though it much improves the quality, does not restore it to the same openness of grain that it had at first.

Trans. Lond. Soc. Arts.

*Lines of equal magnetic dip in Great Britain.* Mr. R. W. Fox, of Falmouth, has made a number of observations of the magnetic dip and in-

tensity in England and Ireland, and lays down from his observations the approximate positions of the lines of equal dip. A remarkable break occurs in these lines in passing from Ireland to England, the line which passes near Dublin, for example, being found on the English coast near the extremity of North Wales, or to the south of the position on the Irish side of the channel. Mr. Fox attributes an important effect on the dip and intensity to trap-dykes, and to basaltic formations; and considers that the usual elevations and depressions of a country modify both of those magnetic elements, elevations increasing the former of them. Third. Ann. Rep. Cornwall Polytech. Soc. 1835.

*Temperature of the muscles in Man.* By the use of thermo-magnetic arrangements, M. Becquerel has determined the temperature of the muscles in man to be  $98.2^{\circ}$  Fah. The subjects of experiment were three young men in healthy condition. Ann. de Chim. et Phys. vol. LIX.

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Progress of Practical and Theoretical Mechanics and Chemistry.

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*On the application of the Hot Blast in the manufacture of Cast-iron.* By THOMAS CLARKE, M. D., Professor of Chemistry in Marischall College, Aberdeen.

(Read before the Royal Society of Edinburgh, March, 1835.)

Among persons interesting themselves in the progress of British manufactures, it can scarce fail to be known, that Mr. Neilson of Glasgow, manager of the Gas Works in that city, has taken out a patent for an important improvement in the working of such furnaces as, in the language of the patent, "are supplied with air by means of bellows, or other blowing apparatus." In Scotland, Mr. Neilson's invention has been extensively applied to the making of cast-iron, insomuch that there is only one Scotch iron-work where the invention is not in use, and in that work, apparatus is under construction to put the invention into operation. Apart from the obvious importance of any considerable improvement in the manufacture of so valuable a product as cast-iron, the invention of Mr. Neilson would merit attention, were it only for the singular extent of the improvement effected, compared with the apparent simplicity—I had almost said inadequacy—of the means employed. Having therefore, by the liberality of Mr. Dunlop, proprietor of the Clyde Iron-Works, where Mr. Neilson's invention was first put into operation, obtained full and free access to all information regarding the results of trials of the invention in those works, on the large scale of manufacture, I cannot help thinking that an authentic notice of these results, together with an attempt to explain the cause of them, will prove acceptable to the Royal Society of Edinburgh. And that these results, as well as the cause of them, may be set forth with clearness, I shall advert,

1st. To the process of making iron, as formerly practised.

2d. To Mr. Neilson's alteration on that process.

3d. To the effect of that alteration.

4th. To the cause of that effect.

I. In proceeding to advert to the process of making cast-iron, as formerly practised, it cannot here be necessary to enter into much detail in explanation of a process, long practised and extensively known, as this has

been; nor, indeed, shall I enter into detail, farther than, to the general scientific reader, may be proper to elucidate Mr. Neilson's invention.

In making cast-iron, then, the materials made use of were three,—the ore, the fuel, the flux.

The ore was clay iron-stone, that is to say, carbonate of iron, mixed, in variable proportions, with carbonates of lime, and of magnesia, as well as with aluminous and silicious matter.

The fuel made use of at Clyde Iron-works, and in Scotland, generally, was coke, derived from splint-coal. During its conversion into coke, this coal underwent a loss of 55 parts in the 100, leaving 45 of coke. The advantage of this previous conversion consisted in the higher temperature produced by the combustion of coke, in consequence of none of the resulting heat disappearing in the latent form, in the vapours arising from the coal, during its conversion into coke.

The flux was common limestone, which was employed to act upon the aluminous and silicious impurities of the ore, so as to produce a mixture more easy to melt than any of the materials of which it was made up, just as an alloy of tin and lead serves as a solder, the resulting alloy being more easy to melt than either the lead or the tin apart.

These three materials—the ore, the fuel, and the flux—were put into the furnace, near the top, in a state of mixture. The only other material supplied was air, which was driven into the furnace by pipes from blowing apparatus, and it entered the furnace by nozzles, sometimes on two opposite sides of the furnace, sometimes on three, sometimes, but rarely, on four. The air supplied in this manner entered near the bottom of the furnace, at about forty feet from the top, where the solid materials were put in. The furnace, in shape, consisted, at the middle part, of the frustums of two cones, having a horizontal base common to both, and the other and smaller ends of each prolonged into cylinders, which constituted the top and bottom of the furnace.

The whole of the materials put into the furnace, resolved themselves into gaseous products, and into liquid products. The gaseous products, escaping invisibly at the top, included all the carbonaceous matter of the coke, probably in the form of carbonic acid, except only the small portion of carbon retained by the cast-iron. The liquid products were collected in the cylindrical reservoir, constituting the bottom of the furnace, and there divided themselves into two portions, the lower and heavier being the melted cast-iron, and the upper and lighter being the melted slag, resulting from the action of the fixed portion of the flux upon the impurities of the fuel and of the ore.

II. Thus much being understood in regard to the process of making cast-iron, as formerly practised, we are now prepared for the statement of Mr. Neilson's improvement.

This improvement consists essentially in heating the air in its passage from the blowing apparatus to the furnace. The heating has hitherto been effected by making the air pass through cast-iron vessels, kept at a red heat. In the specification of the patent, Mr. Neilson states, that no particular form of heating apparatus is essential to obtaining the beneficial effect of his invention; and, out of many forms that have been tried, experience does not seem to have yet decided which is best. At Clyde Iron-Works, the most beneficial of the results that I shall have occasion to state, were obtained by the obvious expedient of keeping red-hot the cast-iron cylindrical pipes conveying the air from the blowing apparatus to the furnace.

III. Such being the simple nature of Mr. Neilson's invention, I now proceed to state the effect of its application.

During the first six months of the year 1829, when all the cast-iron in Clyde Iron-Works was made by means of the cold blast, a single ton of cast-iron required for fuel to reduce it, 8 tons  $1\frac{1}{4}$  cwt. of coal, converted into coke. During the first six months of the following year, while the air was heated to near  $300^{\circ}$  Fah., one ton of cast-iron required 5 tons  $3\frac{1}{4}$  cwt. of coal, converted into coke.

The saving amounts to 2 tons 18 cwt. on the making of one ton of cast-iron; but from that saving comes to be deducted the coals used in heating the air, which were nearly 8 cwt. The nett saving was thus  $2\frac{1}{2}$  tons of coal on a single ton of cast-iron. But during that year, 1830, the air was heated no higher than  $300^{\circ}$  Fah. The great success, however, of those trials, encouraged Mr. Dunlop, and other iron-masters, to try the effect of a still higher temperature. Nor were their expectations disappointed. The saving of coal was greatly increased, insomuch that, about the beginning of 1831, Mr. Dixon, proprietor of the Calder Iron-Works, felt himself encouraged to attempt the substitution of raw coal for the coke before in use. Proceeding on the ascertained advantages of the hot blast, the attempt was entirely successful; and, since that period, the use of raw coal has been extended so far as to be adopted in the majority of the Scotch Iron-Works. The temperature of the air under blast had now been raised so as to melt lead, and sometimes zinc, and therefore, was above  $600^{\circ}$  Fah., instead of being only  $300^{\circ}$ , as in the year 1830.

The furnace had now become so much elevated in temperature, as to require water around the nozzle of the blow pipes, a precaution borrowed from the finery-furnaces, wherein cast-iron is converted into malleable, but seldom or never employed where cast-iron is made by means of the cold blast. What is called the *Twee*, is the opening of the furnace to admit the nozzle of the blow pipe. This opening is of a round funnel-shape, tapering inwards, and it used always to have a cast-iron lining, to protect the other building materials, and to afford them support. This cast-iron lining was just a tapering tube nearly of the shape of the blow pipe, but large enough to admit it freely. Now, under the changes I have been describing, the temperature of the furnace near the nozzles, is such as to risk the melting of the cast-iron lining, which, being essential to the *twee*, is itself commonly called by that name. To prevent such an accident, an old invention called the *water-twee* was made available. The peculiarity of this twee consists in the cast-iron lining already described being cast hollow instead of solid, so as to contain water within, and water is kept there continually changing as it heats, by means of one pipe to admit the water cold, and another to let the water escape when heated.\*

During the first six months of the year 1833, when all these changes had been fully brought into operation, one ton of cast-iron was made by means of 2 tons  $5\frac{1}{4}$  cwt. of coal, which had not previously to be converted into coke. Adding to this 8 cwt. of coal for heating, we have 2 tons  $13\frac{1}{4}$  cwt. of coal required to make a ton of iron; whereas, in 1829, when the cold blast was in operation, 8 tons  $1\frac{1}{4}$  cwt. of coal had to be used. This being almost exactly three times as much, we have, from the change of the cold

\* An incidental advantage attended the adoption of the water-tweers, inasmuch as these made it practicable to lute up the space between the blow-pipe nozzle and the tweers, and thus prevent the loss of some air that formerly escaped by that space, and kept up a bellowing hiss, which, happily, is now no longer heard.

blast to the hot, combined with the use of coal instead of coke, *three times as much iron made from any given weight of splint coal.*

During the three successive periods that have been specified, the same blowing apparatus was in use; and not the least remarkable effect of Mr. Neilson's invention, has been the increased efficacy of a given quantity of air in the production of iron. The furnaces at Clyde Iron-Works, which were at first three, have been increased to four, and, the blast machinery being still the same, the following were the successive weekly products of iron during the periods already named, and the successive weekly consumption of fuel put into the furnace, apart from what was used in heating the blast:

	Tons.		Tons.		Tons.
In 1829, from 3 furnaces,	111	Iron from	403	Coke from	888 Coal.
In 1830, from 3 furnaces,	162	Iron from	376	Coke from	836 Coal.
In 1833, from 4 furnaces,	245	Iron		from	554 Coal.

Comparing the product of 1829 with the product of 1833, it will be observed that the blast, in consequence of being heated, has reduced more than double the quantity of iron. The fuel consumed in these two periods we cannot compare, since, in the former, coke was burned, and, in the latter, coal. But on comparing the consumption of coke in the years 1829 and 1830, we find, that although the product of iron in the latter period was increased, yet the consumption of coke was rather diminished. Hence the increased efficacy of the blast appears to be not greater than was to be expected, from the diminished fuel that had become necessary to smelt a given quantity of iron.

On the whole, then, the application of the hot blast has caused the same fuel to reduce three times as much iron as before, and the same blast twice as much as before.

The proportion of the flux required to reduce a given weight of the ore, has also been diminished. The amount of this diminution, and other particulars, interesting to practical persons, will appear on reference to a tabular statement supplied by Mr. Dunlop, and printed as an appendix to this paper. Not further to dwell on such details, I proceed to the last division of this paper, which is,

#### IV. To attempt an explanation of the foregoing extraordinary results.

Subsidiary to this attempt, it is necessary to discriminate between the quantity of fuel consumed and the temperature produced. For instance, we may conceive a stove to be kept at the temperature of 500° Fah., and lead to be put into such a stove for the purpose of being melted. Then, since the melting point of lead is more than 100° higher, it is evident that whatever fuel might be consumed in keeping that stove at the temperature of 500°, the fuel is all consumed to no purpose, so far as regards the melting of lead, in consequence of deficiency in the temperature. In the manufacture of cast-iron likewise, experience has taught us, that a certain temperature is required in order to work the furnace favorably, and all the fuel consumed so as to produce any lower degree of temperature, is fuel consumed in vain. And how the hot blast serves to increase the temperature of a blast furnace, will appear on adverting to the relative weights of the solid and of the gaseous materials made use of in the reduction of iron.

As nearly as may be, a furnace, as wrought at Clyde Iron-Works in 1833, had two tons of solid materials an hour put in at the top, and this supply of two tons an hour was continued for twenty-three hours a day, one half-hour every morning, and another every evening, being consumed in letting off the iron made. But the gaseous material—the hot air—what

might be the weight of it? This can easily be ascertained thus: I find, by comparing the quantities of air consumed at Clyde Iron-Works, and at Calder Iron-Works, that one furnace requires of hot air, from 2,500 to 3,000 cubical feet in a minute. I shall here assume 2,867 cubical feet to be the quantity; a number that I adopt for the sake of simplicity, inasmuch as, calculated at an avoirdupois ounce and a quarter, which is the weight of a cubical foot of air at 50° Fah., these feet correspond precisely with 2 cwt. of air a minute, or *six tons an hour*. Two tons of solid material an hour, put in at the top of the furnace, can scarce hurtfully effect the temperature of the furnace, at least in the hottest part of it, which must be far down, and where the iron, besides being reduced to the state of metal, is melted, and the slag, too, produced. When the fuel put in it at the top is coal, I have no doubt that, before it comes to this far-down part of the furnace—the place of its useful activity—the coal has been entirely coked; so that, in regard to the fuel, the new process differs from the old much more in appearance than in essence and reality. But if two tons of solid material an hour, put in at the top, are likely to effect the temperature of the hottest part of the furnace, can we say the same of six tons of air an hour, forced in at the bottom near that hottest part? The air supplied, is intended, no doubt, and answers, to support the combustion; but this beneficial effect is, in case of the cold blast, incidentally counteracted by the cooling power of six tons of air an hour, or 2 cwt. a minute, which, when forced in at the ordinary temperature of the air, cannot be conceived otherwise than as a prodigious refrigeratory passing through the hottest part of the furnace, and repressing its temperature. The expedient of previously heating the blast obviously removes this refrigeratory, leaving the air to act in promoting combustion, without robbing the combustion of any portion of the heat it produces.

Such, I conceive, is the palpable, the adequate, and very simple explanation of the extraordinary advantages derived in the manufacture of cast-iron, from heating the air in its passage from the blowing apparatus to the furnace.

*Marischal College, Aberdeen, Jan. 10, 1835.*

#### APPENDIX.

The blowing-engine has a steam-cylinder of forty inches diameter, and a blowing cylinder of eight feet deep and eighty inches diameter, and goes eighteen strokes a minute. The whole power of the engine was exerted in blowing the three furnaces, as well as in blowing the four, and in both cases there were two tweers of three inches diameter to each furnace. The pressure of the blast was  $2\frac{1}{2}$  lb. to the square inch. The fourth furnace was put into operation after the water-tweers were introduced, and the open spaces round the blow-pipes were closed up by luting. The engine then went less than eighteen strokes a minute, in consequence of the too great resistance of the materials contained in the three furnaces to the blast in its passage upwards.

#### *Materials constituting a Charge.*

		cwt.	qrs.	lbs.
1829,	Coke . . . . .	5	0	0
	Roasted Ironstone, . . . . .	3	1	14
	Limestone, . . . . .	0	3	16
1830,	Coke, . . . . .	5	0	0
	Roasted Ironstone, . . . . .	5	0	0
	Limestone, . . . . .	1	1	16
1833,	Coal, . . . . .	5	0	0
	Roasted Ironstone, . . . . .	5	0	0
	Limestone, . . . . .	1	0	0

Table showing the weight of Cast-Iron produced, and the average weight of Coals made use of, in producing a ton of Cast-Iron, at Clyde Iron-Works, during the years 1829, 1830, and 1833, the Blowing-Engine being the same.

COKE AND COLD AIR.			COKE AND HEATED AIR.			COAL AND HEATED AIR.		
1829	Weekly product of Cast-Iron by three Furnaces.	Average of Coals used to 1 ton of Cast-Iron.	1830	Weekly product of Cast-Iron by three Furnaces.	Average of Coals used to 1 ton of Cast-Iron.	1833	Weekly product of Cast-Iron by Four Furnaces.	Average of Coals used to 1 ton of Cast-Iron.
	TonsCwtQs.	TonsCwtQs.		TonsCwtQs.	TonsCwtQs.		TonsCwtQs.	TonsCwtQs.
Jan. 7	137 18 2	8 12 1	Jan. 6	176 10 2	5 2 2	Jan. 9	375 8 0	2 12 3
14	148 2 0	6 9 2	13	181 12 2	5 0 2	16	267 18 0	2 4 2
21	148 8 2	6 11 3	20	172 5 2	5 0 2	23	270 7 2	2 3 1
28	138 9 2	7 0 2	27	178 7 0	4 19 0	30	250 9 0	2 4 0
Feb. 4	125 13 0	7 12 1	Feb. 3	164 8 0	5 4 0	Feb. 6	265 3 2	2 1 0
11	136 19 0	7 13 1	10	172 12 0	5 4 0	13	202 10 0	2 4 3
18	130 16 2	7 11 3	17	163 9 0	5 9 0	20	257 1 0	2 4 3
25	105 12 2	7 10 0	24	170 1 0	5 3 0	27	264 0 0	2 5 1
Mar. 4	101 8 1	7 17 2	Mar. 3	154 19 0	5 10 3	Mar. 6	234 13 0	2 5 2
11	111 2 0	8 2 2	10	154 16 0	5 9 2	13	238 7 2	2 7 1
18	114 10 0	7 6 2	17	151 8 2	5 9 3	20	205 13 0	2 10 2
25	110 14 0	8 8 1	24	163 17 0	5 5 1	27	217 14 0	2 2 3
Ap. 1	111 4 0	8 7 2	31	163 8 2	5 11 0	Ap. 3	220 7 2	2 14 2
8	107 7 0	8 3 0	Ap. 7	147 10 0	5 7 0	10	280 9 2	2 0 3
15	91 12 2	8 15 0	14	154 9 2	5 2 0	17	304 7 0	1 17 3
22	85 13 0	9 13 0	21	163 4 0	4 19 9	24	248 12 2	2 3 0
29	91 14 2	9 6 2	28	148 12 2	5 4 0	May 1	245 7 2	2 6 0
May 6	92 7 2	8 8 2	May 5	162 10 2	5 2 2	8	200 17 0	2 8 0
13	94 6 0	9 2 1	12	149 13 0	5 3 2	15	246 4 2	2 5 3
July 8	88 4 2	8 16 3	19	162 4 0	5 5 0	22	219 1 2	2 6 0
15	91 13 0	8 5 0	26	165 7 2	4 18 3	29	231 2 0	2 8 0
22	97 2 0	8 2 1	June 2	150 4 0	5 2 2	June 5	235 16 0	2 6 2
29	104 15 2	7 10 2	9	157 17 0	5 1 0	12	232 10 0	2 7 1
Aug. 5	106 17 2	7 7 2	16	164 0 0	4 17 3	19	271 1 2	2 1 0
12	93 1 0	8 6 0	23	149 3 0	4 18 0	26	262 3 2	2 3 1
19	113 7 0	8 18 2	30	162 16 2	4 16 3	1 w. 30	122 16 0	2 5 1
	2578 18 0	309 19 0		4215 6 0	134 6 2		6390 3 0	58 18 3
Average.	110 14 2	8 1 1		162 2 2	5 3 1		245 0 0	2 5 1

The correspondent by whom we have been obligingly favored with the preceding paper, makes himself the following remarks on the subject of which it treats.—ED. M. M.

“The best application of the hot blast that I have yet seen, is at the Wilsonton Iron-Works, near Lanark and Whitburn. At these works the heated air is never at a *lower* temperature than the melting point of lead (612°). This is readily *tested* by inserting a small bar of lead into an opening in the pipe for the purpose, a little way before it enters the furnace; the lead is *instantly* melted. When in good working order, zinc is fused (700°) in the same way. The air is heated in passing through a series of iron-pipes of *small* diameter, fixed upright in a brick oven, and kept at a red heat; the heated air entering the furnace by *four tweers*. ‘The Condie pipes,’—so called from Mr. John Condie, the manager of the Wilsonton Iron-Works, and late the Calder—last much longer than the ill-arranged heating-apparatus (with pipes of large diameter) at the Clyde Iron-Works, and effect a much greater saving in fuel.

The *raw coal* when used as the fuel, has the disadvantage of soon filling the furnace, and is also found to produce an inferior quality of iron, to that made by use of coke. It is, therefore not unlikely to be soon, generally, given up.” Lond. Mech. Mag.

## BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*Section of Mechanics applied to the Arts.*

The great press of business in the Physical Section rendered it necessary to institute a sub-section for the Useful Arts, and the increasing interest felt in the subject of Civil Engineering, induced the Association to establish it as a permanent Section of their body, under the designation of *Mechanical Science applied to the Arts*. Of this sub-section Mr. Rennie was appointed President, and Dr. Lardner, Vice-President. Mr. Eaton Hodgkinson reported the result of certain experiments which he had communicated to the Association at the three previous meetings. He also gave the result of some very curious experiments in the Fractures of Wires in different states of tension.

M. Mallet read a paper on the Fracture of bars of Cast Iron.

Mr. Pritchard exhibited an Achromatic Microscope, made by him on the principles published in his works, in which the angular aperture of the object glasses exceeds any that have yet been produced.

Mr. Ettrick read an account of a Mariners' Compass, which by two adjustments, caused the cardinal points on the card to coincide with the corresponding points of the horizon, whereby the mariner is saved the trouble of allowing for the variation in steering, and the expense of purchasing variation plates. It was effected by securing the needle upon the card by moveable clamps, and adjusting such needle for the magnetic variation of Greenwich, with a contrivance for changing it in places having a different local variation.

Mr. Ettrick read an account of certain improvements in Steam Engines, for rendering available the steam of high pressure boilers, which is below the pressure of the atmosphere, by permitting the high pressure steam to pass off into the atmosphere, and the steam of low pressure to pass off into a condenser by a secondary slide. He also gave a report of certain improvements in securing the seams of boilers, by longitudinal, instead of the present circular, clenches, and described a machine for drilling boiler plates, as rapidly as they can be punched by the punching machine. He also gave an account of certain improvements in the astronomical clock.

Mr. Russel read a paper on the Solids of Least Resistance, with reference to the construction of steam vessels, and detailed several experiments to prove, that the object would be best attained by giving a parabolic form to the prow.

Mr. Taylor, the treasurer of the British Association, made a communication respecting the monthly reports of the *duty* of steam-engines, employed in draining the mines of Cornwall; and observed, that he had found at this and other meetings of the Association, considerable interest to be expressed, with regard to this mode of recording the actual effect produced by the consumption of a given quantity of fuel, and recommended the subject to the notice of engineers in general. These reports gave the means of comparing one engine with another in the district; they also afforded an historical view of the progress of improvement in this important machine; and they had contributed largely to that improvement, by the emulation and attention excited by them, in the persons who had the charge of constructing and managing the engines. Mr. Taylor testified to the accuracy of the duty reports, declaring that he had compared them with the account books kept at the different establishments, and found that the results of both coincided.

Dr. Lardner then addressed the section on the subject of Rail-roads.

Professor Stevely described a Self-registering Barometer.

Mr. John Isaac Hawkins explained, on a model, a safe mode of Turning Corners on a Rail-road by means of Mr. Saxton's Differential Pulley. He also read an account of an interesting experiment on the evaporation of water.

Mr. Cheverton read a paper on Mechanical Sculpture, or the production of busts and other works of art by machinery, and illustrated the subject by specimens of busts, and a statue in ivory, which were laid on the table. They were beautifully executed, and excited universal admiration. The machine was invented by Mr. J. I. Hawkins, and perfected by himself.

Mr. Grubb made some observations on an improved method for Mounting an Equatorial Instrument adopted by E. J. Cooper, M. P., in his private observatory. Mr. Cooper bore testimony to the excellence of the instrument, and to Mr. Grubb's talents and zeal in scientific improvements.

Lieut. Denham, R. N. made some observations on the Vibratory Effects of Rail-roads; and a long discussion ensued between Dr. Lardner and Mr. Vignolles on the advantages arising from acclivities in rail-roads.

Rep. Pat. Invent.

*Instance of human effort.—Six Days' Sawing.* A pair of sawyers in the yard of Messrs. Paul and Co., timber-merchants, Broad street, Golden-square, executed the following quantity of labor in sixty working-hours, in six days, beginning about 8 A. M. on Monday, the 25th, and ending about four P. M. on the following Saturday, the 30th of January, in the present year.

They sawed through an area of 3068 square feet of American Pine, along a line whose total length was 1726 feet. In doing this, they raised the saw 124,272 times, and as this tool weighed 30 lbs., they lifted an actual weight of 3,728,160 lbs. But this amount of labour was not more than one-third the actual exertion expended; for to overcome the friction, in pulling up the saw through the kerf, and forcing it down again through the wood, at least two-thirds more was necessary; the total labour, therefore, was equal to lifting 11,184,480 lbs. to the height of the stroke, and as this was four feet, there was 44,737,920 lbs. = 19,958 tons. 18 cwt. raised one foot high, in 60 hours, which is 12,427 lbs. = 5 tons, 11 cwt. raised one foot high, per minute, by the two men, and 2 tons,  $15\frac{1}{2}$  cwt. per man, 1 foot high per minute. Lond. Mag. Pop. Science.

*Improvements in the manufacture of Beet Root Sugar.* In a memoir addressed to the Society for the encouragement of National Industry in France, M. Desormes alleges that the use of animal charcoal in grains for filtering the sirop, and the employment of large quantities of this decolorizing principle, is the greatest improvement recently made in the manufacture of sugar from beets. The charcoal is heated in tin plates, and finally on a cast-iron plate nearly red hot, by which the vegetable matters absorbed by it are decomposed, and the material is again fit for use in removing the color from the sirop. He states the amount of bone charcoal which may be profitably used, as high as one hundred and fifty per cent. of the weight of sugar to be obtained. Bull. Soc. d'encouragement.

*Lime water used in the dressing of Wool.* A patent has been taken out in England for the use of an imperfect soap formed by mixing three parts, by bulk, of a saturated solution of lime in water, with any of the oils used in the preparation and manufacture of wool. The patentee states that the substitution of this composition for oil, will save nearly three-fourths of the oil now used, and much of the soap required in cleansing.

Rep. Pat. Invent. April.

*Analysis of German Silver.* A recent analysis of this compound, by Mr. J. D. SMITH, gave copper, 42.1, zinc 12.5, nickel 13.2, cobalt 2.4 from 70 grains of the alloy. Lond. and Edin. Philos. Mag. Jan.

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## Progress of Civil Engineering.

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*Observations on the Classification and Details of the Architecture of the Middle Ages.* By E. B. LAMB, Esq. Architect.

The study of ancient architecture is fraught with difficulties: one book is examined after another; but, unless you refer to ancient buildings, you seek in vain for a brief and clear classification of the styles, dates, and systems, so essential to the beginner. Many, and voluminous, indeed, are the essays on some particular parts of Gothic architecture; but very few can give satisfactory information, fit for the practical purposes of the art. This is only to be acquired by a close examination of our ancient buildings; and, after having gleaned all that can be learned from books, in the first instance, it will be found impossible to acquire the knowledge thirsted after, without sections of mouldings, and forms which can be studied, properly, only in original buildings; as these forms are seldom to be met with large enough for practical art, in the numerous works with which the world is stocked. Architectural works, in fact, should be looked upon by the student as only the first step in his researches; as, notwithstanding the most careful and elaborate drawing which is bestowed upon their production (and which, as it is well calculated to lure the eye, and from the beautiful representations of buildings and general picturesque style which it displays, must tend much towards improvement in architectural taste,) the details are seldom sufficiently large to enable them to be as properly studied as in the original buildings. The want of this study may, in some measure, account for the deficiency in effect and correctness observed in the modern Gothic; general forms having only been considered by the architect, who, not having acquired a knowledge of the principles of detail, is driven to his own invention; and this generally creates a meagre and insipid design, seldom satisfactory to himself, and often held up to ridicule by others.

I do not mean that ancient architecture should be exactly copied in modern buildings, as this ought never to be the case, I merely recommend close study, that the spirit and feeling of the ancient artist may be understood, that a modern design may be in the spirit of the ancient style, though not in the actual style, and that the mouldings and mullions proper for one date may not be used in another. The architect should always bear in mind, that it is his duty, as it was considered by the architects of the middle ages to be theirs, to invent forms, and improve upon the architecture of by-gone days; yet still to follow the same general feeling, and to create a style perfectly distinct from any other known specimen, which shall be yet perfectly characteristic of the times and purposes for which it is intended. This is to be acquired only by the study of detail, as well as of general forms; and by a knowledge of the principles of the ancient architecture, of the forms belonging to the different periods, of the transitions from one style to another, of the nature of the materials, and of the manner of construction.

Architecture is generally considered one of the most important connecting links in the history of a country; and by the peculiarities of its style,

and its comparison with record, it affords us an interesting insight into the customs of earlier times. This being the case, it is much to be regretted that while our national museum contains some of the magnificent remains of Egyptian and Grecian art, so little regard should be paid to the remains of art in our own country, particularly at the present time, when Gothic architecture is making such rapid strides in the improvements in our cities. I have often thought, when it has been found necessary to take down an ancient building, that it was a public loss, inasmuch as the principal parts would be sold to the collectors of relics, and hidden forever, except to the chosen few. Instances of this kind are constantly occurring: ancient buildings are taken down, being considered either dangerous or inconvenient; the stone is sold, and the carvings, which have delighted and instructed many, are closeted for the benefit of one individual. This is much to be lamented, though it is at present, inevitable; but, if there were a national repository for some of the best selected of these carvings, they might be still a benefit to the world. Some time ago, the north-west tower of Canterbury Cathedral was taken down, and it is to be, or has been, rebuilt, to correspond with the other, which is of more recent date, although a very fine tower. What has become of the Norman remains of the ancient tower? Would it not have been desirable that some of the choicest fragments should be preserved in our national museum? not only as a record of that building, but as an example of early character. Many buildings are thus destroyed, and leave no trace behind, which might contribute considerably to the advancement of this style of architecture, if some of their fragments were preserved, and easy access could be had to them. At a small expense, a very perfect classification of Gothic architecture might be obtained; and, if well arranged, it would greatly tend to diffuse that taste and knowledge in architecture which is so requisite for the promotion of the art. These relics would be constantly before the eyes of the public, who would become familiarized with their forms and date; they would be considered as sacred and valuable records of the history of the art; and would insensibly lead to the preservation of ancient architecture, which has hitherto been so much neglected. It is even probable that churchwardens would catch a little of the infection, and would not suffer a fine building to be "repaired and beautified" by incompetent persons; which has too often been the case in many of our most beautiful buildings. The approaching competition for the Houses of Parliament will at least assist in improving the public taste: it will be the means of awakening the public attention to a style of architecture which raises so many agreeable associations in the mind of an Englishman. In contributing my aid to the illustration of the architecture of the middle ages, I do so with fear, at the same time that I consider it the duty of every architect to assist in promoting that general knowledge which is so essential to the advancement of art, and for the purpose of restraining the rude hands of ignorant men in power, from the spoliations which have been too often suffered by our ancient edifices. In this paper it is my intention to confine myself to a simple classification of the architecture of our own country, principally in the windows, as these are leading features in all our ancient building, and a general knowledge of their forms is a sufficient guide to the date of most other parts of the same building.

The oldest specimens of ancient architecture found in our own country may be probably dated as far back as the fifth century, and ascribed to the Romans (as here it will be unnecessary to mention those extraordinary

works commonly attributed to the ancient Druids;) and these only afford evidences of their authenticity from their mode of construction, as there are now I believe, no records remaining to throw a light upon the exact time of their foundation. The works in this style which are admitted by antiquaries to be genuine Roman works can be the only standard to refer to; and the similarity of other buildings to these will allow of conjecture as to their date. The nave of Brixworth Church, Northamptonshire, retains some of the characteristics of this style of architecture. The walls have recently, in part, been divested of their whitewash, which disfigured them, and the forms of the arches exposed: they are semi-circular, turned with bricks resembling those used by the Romans, and of various dimensions; sometimes in two rims, with a course of bricks laid flat between them, and on the outside rim the soffit of the arch raising quite plain, and at right angles to the face. Among other buildings supposed to be of this period are the remains of Richborough Castle, in Kent, and Jury Wall, Leicester. In many of the churches in Kent, Roman tiles or bricks, the remains of some arches, are still visible; though these remains may be merely the Roman materials brought from other buildings. In the tower of St. Alban's Abbey there is a window of two lights constructed with Roman bricks: in this example, the small pier between the arches may, perhaps, be considered as the prototype of the mullion of a subsequent period.

As the Anglo-Saxons were constantly involved in war, little time was given for the cultivation of the arts; but, about the time that Christianity was introduced in this country, many of the heathen temples were altered to the form required for the new religion. Some were entirely demolished, and Christian churches raised upon their foundations; but the successive invasions of the Danes, and the destruction they every where committed, have left us but few remains of this kind of architecture; and these few so much resemble the Norman style, that it requires the strongest presumptive evidence to assign a building to this period. The general forms were round arches, very few mouldings, massive columns, rudely carved ornaments and capitals, buildings generally upon a small scale, and frequently of unscientific construction. Parts of St. Alban's Abbey are probably of this date; Earls Barton Church, Barton upon Humbar, and some few others, are considered in this style.

The increased refinement in the manners of the Normans, their general love of pomp, and, above all, the comparative tranquility which succeeded to the Saxon sway, produced a new epoch in architecture; though the same general forms were used, the buildings were upon a larger scale, the mouldings were more complex, the ornaments were worked with greater exactness, and the whole improvements were such as would naturally arise from a progression of civilization.

This style is usually comprised between the years 1066 and 1189, which may also be divided into three periods. The first of these, the early style, immediately succeeded the Saxon, and retained many of its features, with very little decoration: examples of this period may be seen in the nave of Rochester Cathedral, built by Gundulph, Bishop of Rochester, about 1077; the tower and other parts of Winchester Cathedral, built by Bishop Walkelyan, about 1080; the Chapel of the White Tower, London, about the same date; and at many other places. The middle period, or division, may be considered the most perfect of this style: the decorations were every where increased, and the chevron, the billet, label, embattled fret, indent, and nebule were among the decorations; the interlacing arches were also

profusely used. Examples of this division may be seen in St. Bartholomew's Church, Smithfield; South Ockendon Church, Essex; the Church of the Hospital of St. Cross, built by Henry de Blois, about 1136, &c. The third division may, perhaps, more properly be called the transition style, from its consisting partly of the perfect style, showing some of the general features of the next. In this division the pointed arch was frequently used; but the ornaments and mouldings retained the same character as in the last, though wrought with an increased complexity. In some instances the pointed arch appeared earlier, as in the Church of St. Cross: in fact, this church has almost all the varieties of the Norman style. The circular part of the Temple Church in London, and Becket's Crown, Canterbury Cathedral, are in this division: in Durham Cathedral there is also some transition work.

The semicircular arch is the characteristic of the Norman style; but in it the horseshoe, the Moorish, the elliptical, segmental, and pointed arches are sometimes to be met with. Windows with three lights, the centre one being raised considerably above the sides, are to be seen in Waltham Abbey, and several other buildings. In Little Snoring Church, Norfolk, is to be seen a semicircular arch within a pointed one, and these two are encompassed by another semicircular arch, with the sides continued from the springing to the impost. There are many examples where the pointed and semicircular arches are both used in the same place, which may be evidence of transition work. *Fig. 1.* is a section of the jamb mouldings of a window

*Fig. 1.**Fig. 2.*

of the middle division. It will be seen by this section that the mouldings are geometrical figures, and are formed out of the flat surfaces of the arches: these arches form distinct recesses, and are very numerous in some buildings. From the peculiar character of the ornament, which, I believe, is always sunk, and never raised above the face of the stone, except in labels, strings, &c., I am inclined to think much of the ornamental work was carved when the arches were set; indeed, some unfinished work, occasionally to be met with strengthens this opinion. Cusps are sometimes found in the later divisions of this style.

The commencement of the reign of Richard I. (1169) is the period usually assigned for the general adoption of the pointed arch, and from the decided change from the massive proportions of the preceding periods to the lofty proportions of the Gothic style, and to that general tendency to perpendicular lines, instead of horizontal ones, which characterised it. Of the numerous names applied to this style of architecture each has its merit in some peculiar way, though but few can be allowed to be sufficiently compre-

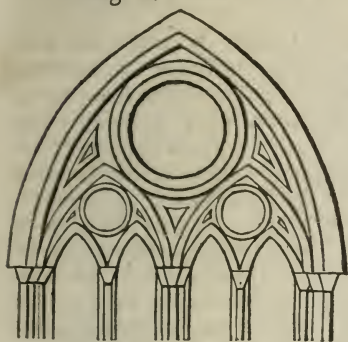
hensive: under these circumstances, I will not presume to add to the catalogue of titles by which it is designated, but shall content myself with the term Gothic, which is generally applied, commonly accepted, and always understood to signify that light and elegant architecture which became general after the Norman style, and which was characterised by the use of the pointed arch and perpendicular lines, as, when so applied, its barbarous definition is never thought of.

The Gothic style may be divided into four classes: viz. 1st Class, which is composed of geometrical forms, in circles and segments of circles, with equilateral and lancet arches; 2d Class, with ramified tracery, sometimes resembling the fibres of leaves, and equilateral lancet arches; 3d Class, with perpendicular lines, and compound arches; 4th Class, also, with perpendicular lines, and compound arches continued, but increased in richness and the number of mouldings; the general proportions being, consequently, more heavy in appearance.

*The First Class of Gothic Architecture*, commenced in 1189, and continued till about 1272; and in the first division of

this class many of the mouldings and ornaments retained some of the characteristics of the Norman style; while among its principal decorations, slender marble columns, highly polished, appear very conspicuously. These columns were introduced perfectly unconnected, except by the capital and base, and were frequently carried to a great height. Where they remain in our buildings in their original state, they produce, by their richness, a beautiful contrast to the plain stone. The square recesses of the Norman style were now changed to plain splays, chiefly in the exteriors, though the interior mouldings were still governed by the same general principles. *Fig. 2*, is a section of the arch mouldings of the east window in the north aisle of Stone Church, Kent, which will show the character of the mouldings of the middle division of this class; and their distinctive marks will be seen by a comparison with those in *Fig. 1*. The degree of progress obtained in the mouldings of this period will also be seen; and by again comparing the section, *Fig. 2*, with the elevation *Fig. 3*, something of the same geometrical character will be observed. *Fig. 4*, is a section of the window jamb, or

*Fig. 3.*



*Fig. 4.*



*Fig. 5.*



*Fig. 6.*



architrave, below the springing of the arch, which more distinctly shows the splaybefore alluded to: it will be proper to mention that this section is not taken from the same window as the other, as that could not be obtained, in consequence of the lower part being entirely enclosed with brickwork and plaster. In this, (*Fig. 4.*) which is from a window of two lights in the same church, are shown two isolated marble columns. *Fig. 5.* is the section of the exterior jamb moulding of the same window. *Fig. 6.* is another specimen of an exterior architrave and label moulding from Rochester Cathedral. *Fig. 7.* is a section of an exterior jamb moulding and mullion, of the first division of this class, from Rochester Cathedral.

*Fig. 7.*



The middle division of the first class of Gothic architecture had scarcely reached its highest point of beauty when it began to decline: and, first, the slender lofty marble column, which had been, from inexperience, formed of marble the laminæ of which were perpendicular instead of being horizontal, split into several pieces, from the weight it had to support; and, consequently, a substitute for this was rendered necessary. This was found by connecting the columns to the mullions in the last division of this style, and by running them up in smaller piers of freestone. The marble column thus gradually got into disuse; and this will account for the decay of many of our early Gothic buildings, and for the necessity, in the next class, of putting in new windows. In buildings of this period, it is not an uncommon thing to see capitals and bases without the shaft of the column. Here, we may reasonably suppose, once stood a marble shaft, which probably split and fell, though bearing little more than its own weight. In the early division of this class, few cusps were introduced into the window heads, and these were only in the perfect figures of the upper parts. Examples of this first division may be seen in Barnes Church, Surrey; Rochester Cathedral, &c.; and of the middle division, in Westminster Abby, about 1245; Wells Cathedral, 1220; and in the east end of New Shoreham Church, Essex, 1220. Stone Church, Kent, is of this division; and in this church, which is one of the most perfect specimens of this class of Gothic architecture, it is curious to observe the increase of richness in the architecture as you proceed from west to east: this practice, which is, I believe, to be seen in all our ecclesiastical edifices, is, in this one very conspicuous. Of the third, or transition, period, some examples are to be seen in Little Maplestead Church. The characteristic arches of this class are the equilateral and the drop arch, with occasionally the lancet specimens of windows. The toothed ornament was much used in this class, in the hollow mouldings; beautiful specimens of which may be seen in Stone Church, and in the arch leading to St. Bartholomew's Church, Smithfield; and also in the restored Lady's Chapel, Southwark.

*The Second Class of Gothic Architecture* commenced about 1272, and continued to 1377. The fault discovered in the marble columns of the preceding class was the means of their disuse; and their places soon became supplied with mullions formed of the same moulding as the tracery mullion; and the geometrical figures of the window heads of the

Fig. 8.



last class were, by slow degrees, made to take the undulating form which belongs to this class. *Fig. 8*, will show the probable origin of this style. In the first division of it, the tracery and mullions were of the simplest kind,

and seldom exceeded a hollow or splay and fillet, both inside and outside: but the fertile genius of the ancient architecture soon produced improved forms; and the windows of the middle division of this class are justly celebrated for their elegance of contour and diversity of design; much of the tracery resembling in the outline the fibres of leaves. Sections of the jamb mouldings are shown in *Fig. 10*. In this section the splayed jamb shows very distinctly that the hollows are remains of the last style; but the mullion is very different. As I

Fig. 10.



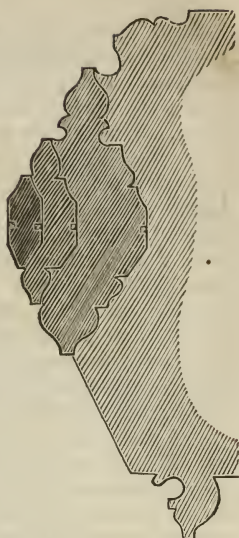
have endeavored to point out, in the other class, the connexion in character between the section of the mouldings and the window heads, here I will again mention this circumstance. The sections of the mouldings, *Fig. 9*, are of a less abrupt and geometrical style than those of the first class; and they partake of the easy flowing lines which are conspicuous in the tracery, and which in both are perfectly distinct from the other class. Thus it will be observed, that the ancient architects, when they diverged from the general compositions of their predecessors, retained the same

spirit in the new designs; for when the change of circumstances necessarily produced a change in the buildings, the spirit of fitness and propriety was still adhered to.

The characteristic arch of this is the equilateral; and the bulb ornament, or ball flower, frequently used in the architrave, or jamb mouldings, belongs to this period: it consists of three leaves clasping a kind of round petal. In some windows this ornament is carried round the hollow of the mullions and tracery, as at Gloucester Cathedral. Examples of the first division of this class may be seen in the organ screen in Canterbury Cathedral, 1304; St. Peter's Church in the Tower of London; Chapel of St. Stephen, Westminster, about 1330, &c. Examples of the middle division of this class will be found in the spire of Salisbury Cathedral, parts of Rochester Cathedral, and in many of the churches at Oxford; and in most of which buildings there are also examples of the last, or transition, division, which may also be seen in the west end of Gloucester Cathedral.

(TO BE CONTINUED.)

Fig. 9.



## Mechanics' Register.

*Plate Glass.* The casting of plate-glass has, since the first discovery of the invention, been an important branch of French manufacture. The invention is owing to Abraham Thevart, who, in the year 1688, introduced it to the notice of the French administration, and received due encouragement. Under their protection and assistance, the manufactory at the Castle of St. Gobin, three leagues from Laon, was established. This is the most extensive plate-glass foundry in France; it has gradually increased in its number of furnaces, fages, and appendages, until it now presents the appearance of a town, rather than a manufactory. A plate has been lately cast here of the extraordinary dimensions of fifteen feet by twelve, for the Château des Thuilleries. British plates are now equal in quality to the best French specimens, but they are more subject to a degree of undulation, which distorts the appearance of objects: this defect is probably owing to the mass not being continued in a sufficient state of fusion, during the progress of the operation of casting. Lond. Jour. of Arts.

*The Ice trade between America and India.* The arrival of the Tuscan with a cargo of ice from America, forms an epoch in the history of Calcutta. So effectual was the non-conducting power of the ice-house on board, that a thermometer placed on it did not differ perceptibly from one in the cabin. From the temperature of the water pumped out, and that of the air in the run of the vessel, Mr. Dixwell ascertained that the temperature of the hold was not sensibly affected by the ice. Upon leaving the tropic, and running rapidly into higher latitudes, it retained its heat for some time; but after being several weeks in high latitudes, and becoming cooled to the temperature of the external air and sea, it took more than ten days in the tropics before the hold was heated again to the tropical standard. Asiatic Jour.

*First Tunnel under the bed of a navigable river.* This tunnel has been successfully made under the stream of Black Water, at Waymouth. The river has thirteen feet of water at high tide, and seven at low. The tunnel, so called, is intended for the passage of a main gas pipe, and is seven feet high by four and a half wide. Its length is upwards of four hundred and fifty feet. Abstract Rep. Pat. Invent.

*British Institution of Civil Engineers.* This Institution which now numbers seventeen years since its origin, is about to publish its transactions. The publication has grown out of their weekly meetings for conversation on business connected with the profession. Ibid

*Access to the Cornish mines.* This is had by nearly vertical ladders interrupted at intervals by platforms. In issuing from the depth of from twelve to fifteen hundred feet the miner occupies more than one hour, and on a moderate estimate, it has been calculated, expends one fifth of his force in going to and returning from work. Ann. Rep. Cornwall Plytech. Soc.

*Spider Silk.* In France, M. Bon has had gloves and stockings manufactured from the spider's cocoon.

*Cause of the earthquakes in the Ionian Islands.* Doctor Davy finds an adequate cause for those in the access of water to the calcareous marl deposits of those engines. The marl swells when water is thrown upon it. In Aphalonia, there is a remarkable case of four descending streams of sea water, which disappeared below the surface. The subjacent strata are of the kind referred to above. An ingenious Englishman has put one of these streams to practical profit, by establishing a grist mill on its site.

*Patent Caoutchouc Cloth.* A case of considerable interest arising under the patent of Messrs. Mackintosh & Co. of Glasgow, for water cloaks, has recently been decided in the Court of Common Pleas, London, before the Chief Justice and a jury. The verdict was for the plaintiffs, Messrs. Mackintosh & Co. Lond. Mech. Mag.

*List of American Patents which issued in May, 1836.*

	<i>May.</i>
332. <i>Feather dressing.</i> —B. S. A. Todd, Marietta, Ohio.	6
333. <i>Flyer for spinning.</i> —Samuel Ladd, Waltham, Mass.	6
334. <i>Pump.</i> —J. F. Walther, Easton, Penn.	6
335. <i>Balance.</i> —Jirah Vaughan, Rutland, Va.	6
336. <i>Cutting vegetables.</i> —Austin H. Robbins, Denmark, N. Y.	6
337. <i>Horse power.</i> —Amos Adams, Augusta, Maine.	6
338. <i>Botanic medicine.</i> —Samuel Thompson, Boston, Mass.	6
339. <i>Shoe making machine.</i> —James Hall, North Bridgewater,	6
340. <i>Thrashing and shelling machine.</i> —Nicholas Goldsborough, Easton, Md.	6
341. <i>Raising water.</i> —Joseph Turner, Poland, Maine,	6
342. <i>Thrashing machine.</i> —George Beaumont, Mount Pleasant, Penn.	6
343. <i>Stove.</i> —Nathaniel Russel, Waterville, Maine,	14
344. <i>Canal lock indicator.</i> —Valentine Brown, Clifton Park, N. Y.	14
345. <i>Canal lock gate.</i> —Valentine Brown, Clifton Park, N. Y.	14
346. <i>Water, applying.</i> —J. Hinds, M. B. Ball, and S. Pike, Troy, N. Y.	14
347. <i>Sawing machine.</i> —Joseph Peevy, Levant, Maine,	14
348. <i>Washing machine.</i> —L. R. Prince, Beverly, Mass.	14
349. <i>Pearl ashes.</i> —J. and N. Parce, Linckland, N. Y.	14
350. <i>Distilling, cold.</i> —A. V. H. Webb, Utica, N. Y.	14
351. <i>Canal lock.</i> —David Wilkinson, Cahoes, N. Y.	14
352. <i>Plane.</i> —John T. Jones, Philadelphia,	14
353. <i>Grate.</i> —James Bennett, New York,	14
354. <i>Horse power.</i> —Isaac Straub, Lewistown, Penn.	14
355. <i>Saw mill.</i> —W. J. McGhee, Columbus, Geo.	14
356. <i>Sawing timber.</i> —Joshua Webb, Brooklyn, Conn.	14
357. <i>Cannon traverse board.</i> —Wm. H. Bell, Washington, D. C.	14
358. <i>Spinning machine.</i> —John Morgan, Manyunk, Penn.	14
359. <i>Mill wheel.</i> —S. H. Freeman, Cecilton, Md.	17
360. <i>Platform balance.</i> —C. P. Ladd, Irasburg, Vermont,	17
361. <i>Horse rake.</i> —Erastus S. Root, Mount Morris, New York,	17
362. <i>Brooms and brushes.</i> —Thos. Kinsley, Cabotville, Mass.	17
363. <i>Regulating machinery.</i> —Nathan Scholfeld, Norwich, Conn.	17
364. <i>Butt Hinges.</i> —Jonas Rouse, Troy, N. Y.	17
365. <i>Cider mill.</i> —Elias Jenkins, Harmony, Penn.	17
366. <i>Platform balance.</i> —Jas. M. Peck, Syndon, Vermont,	23
367. <i>Kitchen range.</i> —Geo. Johnson, Philadelphia,	23
368. <i>Clock spring.</i> —Joseph S. Ives, Bristol, Conn.	23
369. <i>Horse power.</i> —C. Custer and D. Pennypacker, Upper Providence, Penn.	23
370. <i>Cart and carriage wheels.</i> —William Woodbridge, Kennebec, Maine,	23
371. <i>Steam engine.</i> —A. S. Dawley, Boston, Mass.	23
372. <i>Spark extinguisher.</i> —A. Whitney and S. S. Burr, Albany, N. Y.	23
373. <i>Locks.</i> —P. B. Quimby, Belfast, Maine,	23
374. <i>Feather dresser.</i> —George Reynolds, East Hartford, Conn.	23
375. <i>Timber, slitting.</i> —R. Beale and M. Bucklin, Grafton, N. H.	23
376. <i>Building stores, &amp;c.</i> —Isaac Knight, Baltimore, Md.	23
377. <i>Tanning.</i> —Simeon Heath, Pike, N. Y.	23
378. <i>Water wheel.</i> —William Hitchcock, Spencer, N. Y.	23
379. <i>Reed making machine.</i> —J. A. Wilkinson, Providence, R. Island,	23

## CELESTIAL PHENOMENA, FOR SEPTEMBER, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.						
5	14	56	Im	c	Geminorum	,6,	101°	47°
5	16	1	Em				264	206
20	9	19	Im	m	Capricorni	,6,	95	104
20	10	31	Em				314	336
22	11	20	N. App. Dand $\sigma^2$ Aquarie, 5.6, $\searrow$ N. 3.'5					

## Meteorological Observations for May, 1836.

Moon.	Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
☉	1	44°	70°	30.24	30.30	W.	Moderate.	Inches.	Clear day.
	2	58	81	30.00	30.00	SW.	Breeze.		Clear day.
	3	64	83	29.70	29.70	S. W.	do.		Cloudy—partially cloudy.
	4	67	74	29.70	29.60	N.W.	do.		Lightly cloudy.
	5	48	72	30.00	30.00	N.	do.		Clear day.
	6	42	74	30.96	30.00	W.	do.		Lightly cloudy—clear.
	7	53	66	30.85	29.60	E. SW.	Moderate.		Rain—Cloudy.
	8	55	66	30.76	29.86	N.E.	do.		Cloudy—lightly cloudy, aurora B.
	9	46	66	30.00	30.06	S.	do.		Clear day.
	10	42	74	29.90	30.16	SWS.	do.		Lightly cloudy.
	11	46	78	30.04	29.19	E. S.	do.		Partially cloudy.
	12	58	78	29.70	29.60	N.W.	do.		Lightly cloudy.
	13	64	65	29.50	29.70	N.	do.		Partially cloudy.
	14	39	66	30.20	30.24	NW, S.	Brisk.		Partially cloudy.
	15	42	69	30.24	30.20	S. W.	do.		Lightly cloudy.
	16	52	80	30.05	30.00	S. W.	Moderate.	.4	Clear—Sun set—clear, very dry
	17	61	82	29.90	29.90	W.	do.		Lightly cloudy—clear—shower.
	18	60	88	29.90	29.90	WSW.	do.		Clear—floating clouds.
	19	59	79	30.07	30.07	NW. W.	do.		Clear—floating clouds.
	20	54	80	30.10	30.10	S. SSW.	Brisk.		Clear—lightly cloudy.
	21	64	90	29.90	29.85	W.	do.		Lightly cloudy.
	22	60	86	29.80	29.86	W.	do.		Clear—flying clouds.
	23	61	84	29.70	29.70	S. W.	Moderate.		Clear—flying clouds.
	24	66	64	29.70	29.70	S. E.	Brisk.	.5	Clear day.
	25	53	68	29.65	29.65	SE.	Moderate.		Drizzle—cloudy.
	26	54	64	29.83	29.90	SE.	Brisk.	.25	Cloudy—rains in night.
	27	47	51	30.00	30.00	E.	Moderate.		Drizzle—rain—cloudy.
	28	49	67	29.86	29.83	N.E.	do.	1.20	Drizzle—cloudy.
	29	62	69	29.80	29.83	E.	Brisk.	.8	Drizzle—rain in night.
	30	46	52	29.86	29.90	N.E.	do.		Drizzle—cloudy.
	31	44	54	29.95	29.95	NE.	do.	1.62	Cloudy—cloudy.
☾	Mean	53.54	72.03	29.90	29.90				

Thermometer.

Barometer.

Maximum height during the month. 90. on 21st.

30.24 on 1st, 14th, 15th.

Minimum do. 62.93

29.50 on 13th.

Mean do. 62.93

29.90

**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
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**MECHANICS' REGISTER.**  
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**Mechanical and Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

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SEPTEMBER, 1836.

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**Practical and Theoretical Mechanics.**

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*On the manufacture of Military Projectiles, translated from the French of F. I. Culmann, Chef d'escadron d'artillerie, &c. &c. By ALFRED MORDECAI, Captain United States Ordnance Department.*

(CONTINUED FROM p. 90.)

*Of Rolling Shot.*

Shot are rolled in a cast-iron barrel closed at the ends, having an elliptical door, and fixed on an iron axis which communicates with the shaft of a wheel from which it receives motion.

There are no fixed dimensions for such a barrel; one three feet long, twenty-two or twenty-four inches in diameter, will serve to roll as many shot as can be hammered under one hammer. The barrel should be very strong, eighteen or twenty lines thick and hooped with iron. It should be half filled; if it were less full, the shot would be less quickly polished, as we might suppose by considering the pressure which they exert on one another. This barrel ought to make about twenty or thirty turns in a minute: if the velocity were too great the shot would acquire a centrifugal force, which, pressing them against the sides of the barrel, would prevent them from acting on each other: on the other hand if the motion were too slow, or if the cask were too full, the shot would not strike with sufficient force.

When the shot are not of white metal, which, on account of its hardness, is acted on with difficulty, the charge may be renewed every two or three hours.

Rolling polishes the surface of the shot and exposes slight flaws; but it cannot correct a defect of sphericity, nor can it remove the marks of the seam and the gate. We are far from thinking that it can be substituted for hammering, which ought necessarily to follow it. Shot which have been first rolled may be hammered more quickly and at a lower heat, and receive a much finer surface. The small expense therefore which it occasions, is compensated in hammering, by a saving of fuel and labor: of undoubted advantage to the service of the artillery, its adoption will not increase the expenses of the foundry.

Even if the shot were perfectly spherical when they come out of the polishing barrel, it would be better to have them hammered, because the hammer subjects them to a certain proof, very imperfect it is true, and because rolled shot are liable to oxidation, whilst those which have been hammered are covered by a slight coat of oxide, which generally protects iron and preserves it from further oxidation.

### *Of Hammering Shot.*

The object of hammering is to make the shot more spherical and its surface more even, by removing all the little irregularities, the mark of the gate and that of the seam. The operation is performed on the heated shot, under a hammer weighing from sixty to seventy kil, (130 to 150 lbs.) the face of which is a spherical cup of the depth of eight or nine lines.

The shot are heated in a reverberatory furnace of a particular construction. The floor, which is inclined, is from fifteen to eighteen feet long, and eighteen inches wide. The height of the arch is fourteen inches. The shot introduced at one end of the furnace, descend by the inclination of the floor, and reach the point where the heat is greatest; when they have acquired the requisite degree of heat they are taken away by the workmen, whilst other shot descend into their places. By such an arrangement the work is facilitated and the shot are left the least possible time exposed to the greatest heat, which prevents too great an oxidation. The scales of oxide fall off under the hammer, and leave on the shot marks of a depth proportionate to the thickness of the scale.

At Hayange, wood is used for heating the shot; at other places coal has been successfully employed. The degree of heat ought to depend both on the nature of the metal, and on the degree of imperfection in the form of the shot. If it is nearly spherical, especially if it has been first rolled, and if the metal is good, of a clear grey, it may be heated very low, to a brownish red only, and the shot will be the better. In general, cast, like wrought iron, when worked under the hammer or between rollers, at a very low temperature, has a finer appearance than if the temperature had been higher. But if the shot be not spherical, or if it be of white metal, it is necessary to heat it very much, and to suffer the disadvantages which result from it. A great many of these shot then break under the hammer and the others are always defective. This never fails to occur when they are cast with white metal.

They are generally heated at Hayange, only to cherry red. A workman draws the shot with a hook to the mouth of the furnace, another seizes it with the tongs and carries it first, according to the old practice, to the filer who removes the seam and the gate with a rasp.

This operation is faulty, because the filer often takes off too much metal on one side, and makes the shot sometimes too small; always more or less irregular in form: it is not practised with shot cast in sand, and might very well be also dispensed with for those which are cast in iron moulds, although their seam is thicker than that of the others. The workman who has carried the shot to the filer, takes it again, and places it under the hammer, where another turns it with the tongs so that it may be hammered in every direction, but principally on the seam and on the gate. It should receive from 120 to 150 blows of the hammer to pass inspection.

If the shot has not been rolled, it is necessary to prolong the hammering on the seam, in order to flatten it entirely; the yielding of the metal to this compression, produces an elongation towards the poles. This effect is imperceptible in shot which have been first rolled; because after that operation there remain but slight traces of the seam which disappear at the first blows of the hammer, and because, moreover, they ought to be heated and hammered at a low temperature.

A small stream of water is made to drop constantly on the shot; insinuating itself between the metal and the coat of oxide, it evaporates, throws off the scales, and increases the polish of the surface. When the shot has been sufficiently hammered, the workman who has brought it pushes it down with another, so that the hammer is not stopped. But in spite of the attention and skill of these workmen, it is impossible that a hammer which strikes 200 times in a minute, should not sometimes strike foul when the shot is changed; it would therefore be better to stop the hammer, either by supporting it with a prop, or disengaging it from the moving power. These foul strokes leave very deep marks, because the hammer and the anvil are both hollow and the edges are consequently very sharp. For the same reason even the hammer makes small marks, though much less perceptible than those of which we have just spoken, when it is badly fixed on the handle, or when, by use, it has been thrown out.

In passing from one caliber to another a little larger, it is not necessary to change the hammer or the anvil; it is sufficient to heat them a little, in their places, and to make the hammer strike on a cold hammered shot, of the caliber of those which are to be next hammered.

If the shot is not spherical when it comes from the mould, it can be made perfectly so by hammering, provided the inequalities are not too great, and that the metal is grey. A slight elongation then disappears entirely. A flattening at the poles is more difficult to correct.

#### *Comparison between Shot cast in Iron Moulds and those cast in Sand.*

Shot cast in iron moulds are generally less round than those cast in sand; they have besides the defect of a coating of white metal two or three lines thick, even when they have been cast from the best metal, that which is clear grey.

This coat of white metal proceeds from the sudden cooling of the metal when poured into these metallic moulds, which are undoubtedly the best conductors of heat. Owing to these two circumstances it is necessary to expose these shot to a high heat, for the white metal is difficult to hammer. Their surface becomes therefore much furrowed, and, notwithstanding, it is not always practical to make them spherical. There are also many kinds of iron which do not bear a great heat. Shot made of such iron, when heated to a rose red, begin to break under the hammer, the white metal

especially then breaks very easily, and yet it is this kind which requires a high heat in order that all the roughness may be removed.

Depressions and swellings, in short any defects of sphericity, will still appear after hammering, if the metal is white; and the shot will be besides too small.

Whatever care may be taken to skim the metal when it is poured into the mould, there will always enter a certain quantity of dross; the metal is also oxidated in passing through the air. This dross and this oxide, being at a high heat, may combine with the sand of the mould which absorbs them. In the iron moulds, on the contrary, they float on the surface of the metal, and collect at the upper pole of the shot, around the gate. These impurities are partly removed by hammering, and leave their impressions on the surface of the metal; another part of them is incrustated still more firmly on the surface of the shot which then becomes rough, uneven and scarred, or according to the expression of the workmen, *scabby*.

These defects are increased by the use of an impure metal, mixed with silex, such as the metal obtained by the use of coke of inferior quality: it may be known by its want of fluidity.

We see then that shot cast in iron moulds are defective:

1st. From want of uniformity of dimensions which prevents the requisite accuracy;

2nd. From want of sphericity;

3rd. From having a rough and furrowed surface, principally at the upper pole.

From these causes they are of a quality very inferior to that of shot cast in sand; there would besides be little gained by rolling shot cast in iron moulds, because their surface is too hard.

The faults just mentioned are not found to the same extent in all founderies, although they are inherent in this method of fabrication. On the other hand, shot which are cast in iron moulds, have a greater specific gravity than those cast in sand. This fact which seems at first sight so singular, is easily explained: we have already remarked that by a greater compression of the sand, we may obtain, with the same model, smaller shot than if the sand were loose, on account of the resistance offered to the expansion of the metal; now this resistance is very much increased by the use of iron moulds closely wedged together. Another cause of the greater specific gravity of such shot is connected with their greater defect, the coat of white metal which envelopes them, and which resists the operation of the hammer. There are some metals however, which are very little whitened by sudden cooling, and shot made of them, when cast in iron moulds, may be perfectly spherical after having been hammered.

Shot cast in sand, although always less indented than those cast in iron moulds, are yet somewhat so, and become more so in proportion as the metal is less pure and less fluid. This indented surface is owing to the scales of dross detached from it, or pressed into it by the hammer.

These impurities may be produced in the furnace, or they may adhere to the shot before they are taken to the furnace: accidental causes may also occasion them. Argillaceous sand, or mud adhering to the surface, may become vitrified in the fire by absorbing oxide of iron, and may produce indentations. A rusty shot has not so fine a surface after hammering as a clean one. It is therefore very improper to throw shot into the mud, or to expose them to rain, after they have been cast. The sand which comes from the mould, and which has not been entirely removed by the rasp, may

also occasion these defects; hence again the advantage of having shot rolled before they are hammered.

Cavities, more or less apparent, are great defects in shot; almost all shot have a cavity in the centre, and when there is none, it is remarked that the metal is less dense or more spongy there than in other parts: it always appears a little grey at that point, even if it is otherwise white. But the principal cause of rejection in some founderies, is the existence of small cavities near the superior pole of shot; these holes are often so small on the exterior that it is difficult to introduce a pin, but they are sometimes deep and always large within, and form real chambers. The shot cast of liquid white metal have not this defect; it appears more decidedly in proportion as the metal is less liquid and more grey. It is probably for the same reason, less sensible in shot cast in iron moulds.

The hammer does not afford a test of these shot which are full of little cavities; it breaks only those which are of white metal, or those which have been too much heated. Shot which are too small may be corrected by being heated and very slowly cooled, which is performed by placing them in hot cinders, or small live coals mixed with ashes, and letting them remain twenty-four or forty-eight hours. They must then be hammered a second time, because their surfaces become oxidized and very rough. These shot also are frequently made larger by hammering. It would therefore be a very bad way of trying to diminish the diameter of the shot by hammering it repeatedly. It can be done only by oxidizing it very much, which, at last, lessens the size of the shot by corrosion; but the surface becoming in that case very much indented, that operation should not be permitted.

It has been attempted to make use of broken or unserviceable projectiles, by recasting them in the Wilkinson furnace; but that operation which was performed in the arsenals has not been found, in any respect, advantageous. Cast-iron melted a second time, where it is of a good quality, generally gives better results than are obtained from the ore; but iron which is to be melted a second time ought to be of a grey colour, and obtained from ore of rather a refractory kind; it is also necessary that it be melted in crucibles of considerable height. When these conditions are not fulfilled, the metal cannot acquire sufficient fluidity, it becomes thick, white, and unfit for casting in moulds. Now the iron of broken projectiles, generally obtained from very fusible ores, almost always inclines to white; this tendency must be much increased by melting it in low furnaces; if the height of the crucibles were increased, a greater power would be required to move the bellows. It is to be remembered also, that good shot cannot be obtained without rolling and hammering, operations which require machinery, the establishment of which would be disproportioned to the object in view. These shot too, after having been rolled and hammered, would probably be inferior to those which may now be obtained at the founderies; since the material of them is not adapted for melting a second time, particularly when that operation is performed in low furnaces.

The experiments just mentioned, prove, however, that it is possible, by means of very simple contrivances, to make serviceable shot out of broken pieces, or shot of other calibers than those required. If therefore, in a besieged place, the supply of shot should fail, a certain quantity might be procured by this means: and if the quantity of material were sufficient to authorize it, a rolling barrel might be cast, and the shot would then be very good.

*Of the inspection of Projectiles.*

The following instruments are used for the inspection of projectiles:

1st. Cylinders, five calibers long, the diameter of which is one line less than that of the piece if for field pieces, and one line and a half for siege pieces.

2d. Three gauges, the largest has the same diameter as the cylinder, the smallest nine parts less for shot, one line less for bombs, and six parts less for six inch and twenty-four pound howitzes; the intermediate gauge is of use only to test the accuracy of the fabrication: if good, three-fourths at least of the projectiles ought not to pass through that gauge, although none can be rejected, if they should all pass through it. It was an error to prescribe, as was formerly done, to obtain projectiles of a mean diameter between the two gauges: the effort should always be to approach as nearly as possible to the larger.

3rd. Callipers, with gradual limbs, of different sizes, to measure the thickness of metal in hollow projectiles.

4th. Probes, or gauges, for measuring the thickness of metal at the point opposite to the eye.

5th. Cylinders for verifying the interior and exterior diameters of the eye.

6th. Gauges cut in small pieces of sheet iron, showing the maximum and minimum thickness of the shell at the eye.

7th. A hand hammer, with one face flat, and the other pointed.

8th. Benches, or tables, of thick plank.

9th. Fine pins for discovering and sounding cavities.

*Of the inspection of Hollow Projectiles.*

Under this head are included grenades, twenty-four pounders, six inch and eight inch howitzes; ten inch and twelve inch shells.

Before commencing the inspection, the instruments should first be carefully examined. The hollow cylinders as well as the ring gauges, are tested with verifying cylinders, intended for that purpose only. The gauges for the eye are measured with a nonius or else with a caliber ring made for the purpose. It is not necessary to make frequent verifications of these gauges, because their diameters cannot increase. Not so with the ring gauges, they should be verified whenever they are used, as the friction to which they are exposed in the inspections tends to increase their diameters.

The points of the callipers wear away very rapidly; they should therefore be frequently examined by closing them, and seeing if the points touch each other, when the upper branch corresponds to the zero of the graduated limb: the same remark applies to the probe.

The variations allowed in the thickness of the metal, or the differences between the respective maximum and minimum, are one line for twenty-four pounders, and six inch howitzes; two lines for eight inch shells, and four lines for ten and twelve inch. Formerly a variation of two lines was allowed for six inch howitzes, but one line is amply sufficient; eighteen parts would be enough for eight inch shells, and two lines for twelve inch; that is, one line above and one below the diameter of the intermediate gauge.

The variation allowed for the thickness of the culot, is generally one half of that allowed for the sides of the shell, except in six inch and twenty-four pound howitzes, in which the same variation is allowed, if indeed, they are not concentric.

There are no determinate variations allowed for the eyes; but Gassindi

recommends the rejection of shells the eyes of which differ three parts from the given dimensions. The exterior diameter differs one line from the interior, in bombs, and nine parts in howitzes.

The cylinder gauge is not used for bombs, and might without any inconvenience, be dispensed with for howitzes; it is much easier to judge of the roundness of these large projectiles, by applying the intermediate ring gauge, than by letting them roll through a cylinder inclined one inch in five calibers; as prescribed in the aide-memoire.

In order that the inspections may be made without confusion, and with proper accuracy and rapidity, the work should be divided between, at least, four inspectors, assisted by four or six gunners. One inspector holds the ring gauges, another measures the thickness of the shell at the eye and examines it with reference to flaws or cavities: a third verifies the thickness of metal at the sides; a fourth, the thickness at the bottom: the gunners clean the projectiles, place them on the bench, pass them from one inspector to another and then throw them on the pile to which they belong.

The inspector who has the ring gauges, rejects all the shells that will not pass through the larger gauge, or that pass through the smaller one, even in one direction. He distinguishes those that pass through the intermediate gauge, and they are placed in a separate pile, after they have passed the other inspectors. He examines them with respect to sphericity, which is easily judged of by the assistance of the gauges, and he rejects those which are either flattened or elongated at the poles.

The inspector whose business it is to examine the flaws or cavities, begins by measuring the thickness at the eye, he then inserts his finger, to discover interior cavities, which are sometimes numerous, and which are a cause of rejection. He afterwards examines the exterior, particularly at the gate, or near the eye. If he sees at once, that the metal is not compact, he searches the cavities and rejects the shell if he finds any cavity which becomes larger in the interior, or which extends to the depth of two lines. He strikes with the face of the hammer around the eye, to detach any scales that may be found there, and to judge by the sound, of the density of the metal. If he has doubts with regard to a cavity, he uses the point of the hammer, but cautiously, so as not to injure the shell too much; if there is a decided cavity, he strikes forcibly in order to lay it open, and to deface the shell which is then rejected. In the contrary case, if the dimensions of the eye are within the prescribed limits, and if there are no other defects, he passes the shell to the next inspector.

The inspector who has the callipers measures the thickness of the sides in four places: it is essential that the points of the callipers should be applied to the seam, the only circle on which the callipers can measure the normal thickness; the *minimum* thickness indicated by the callipers must be always taken. Finally, the shell is passed to the person who has the probe. The manner of using this instrument depends on its form. If it be so constructed that the stem can in any way be placed exactly in a direction perpendicular to the plane of the seam, and to the surface of the projectile, it is sufficient to place it with care, and to take the measure indicated, either by the nonius or by a simple division. When the probe has not such a construction, its position must be a little varied, as is done with the callipers; but the measure of the thickness of the culot must be the *maximum* shown by the instrument, because the greatest thickness is necessarily found on the line of the poles. These trials are very rapidly

made, a great facility being soon acquired by practice, because the requisite motions are few and limited.

It is to be observed that the sides of the eye do not serve as a guide for placing the stem of the probe in the direction of the line of the poles; the axis of the eye may often be out of that line, as we may suppose from the manner in which the shell is finished; the eye being reamed out when the metal is hot, and the reamer being guided only by the hand of the workman. Hence, the slightest deviation, almost imperceptible at the eye, will throw its axis out of the direction of the poles. On this account it is often requisite to vary a little the position of the instrument, which is also frequently rendered necessary by accidental circumstances met with in the shell; such as a slight cavity, or small projection, not sufficient to cause its rejection. In that case we must place the instrument by trial, even if it should have the advantage we have mentioned; as has for instance, the one invented by Col. Moret. It often happens, that a defect is not sufficiently great to cause the rejection of a shell, whilst it may still be rejected for a number of such small defects.

Bombs are inspected in the same manner as howitzes. Great attention should be paid to the ears, the metal of which is not always sound; that is the weak part of this kind of projectile. It is also necessary that the rings should have free play, and should fall down entirely on the surface of the shell. Bombs are scarcely ever rejected for the irregularities in the thickness of the sides, because the variations allowed are so great that even the least skilful workmen seldom exceed them.

#### *Of the inspection of Shot.*

The inspection of shot is much more simple than that of shells. When they are well cleaned, (and they should always be inspected as soon as they come from the foundery, before they become covered with rust,) they should be very carefully examined, and the cavities searched with a pin as in the case of shells. They are made to turn in the large gauge, and the small gauge is then applied to them in several directions: their roundness is judged of by means of the intermediate gauge. They are rejected for depressions, flaws, or other cavities of two lines in depth. Those that pass this inspection are made to roll through the cylinder gauge which should have an inclination of two inches in a length of five calibers. The shot which pass through the intermediate ring gauge, are placed in a separate pile.

The cylinder should be frequently turned that it may not be too much worn on one side. When a shot becomes wedged in the cylinder it is pushed out at the upper end, with a wooden handle. Formerly, when shot were cast in iron moulds, this accident very often occurred; not being spherical they sometimes passed very easily, in several directions, through the ring gauge, and afterwards stopped in the cylinder. About twenty of the shot received should be weighed; their weight is generally greater than that given in the tables, or than their denomination calls for; because it is endeavored to obtain shot which approach the dimensions of the large gauge, whilst the tables have been calculated on the diameter of the intermediate gauge. If this principle were strictly observed, the fabrication would be easier, but the shot would have greater windage than those which are now made, and in this respect, would be less servicable.

The contractors remove at their own expense the projectiles which are rejected; but as their interest should be consulted as far as is compatible wit

that of the service, partial inspections are made at the founderies, and these give rise to the greater number of rejections.

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*Report of Thos. Jefferson Cram, Principal Assist. Prof. Nat. and Exp. Philos. U. S. Mil. Academy, upon experiments relative to the strength of Cast-iron beams.*

[COMMUNICATED BY PROF. A. D. BACHE.]

1. Soon after the destructive conflagration which devoured a large and valuable portion of the city of New York, last winter, as a very natural consequence, the attention of capitalists became more fully awakened to the importance of constructing fire-proof buildings. Accordingly a demand was made upon Gov. Kemble, Esq. Principal of the West Point Foundry, for estimates of the cost of furnishing cast-iron, to replace the combustible parts which had hitherto been used in the interior of store houses and shops. To answer fully the demand which had been made upon him, Mr. Kemble thought it expedient to make a careful series of experiments upon the relative strengths of cast-iron beams of various forms, in order to ascertain, beyond a doubt, those which would be convenient for the particular object in view, and which would, at the same time, afford the greatest strength with the least cost. Through the politeness of Mr. Kemble, I had an opportunity of being present at the time of subjecting his cast-iron beams to the test of experiment; and believing that the results of those experiments will prove highly useful to the cause of constructions in general, the writer of this begs leave to make them public through the medium of the Journal of the Franklin Institute.

2. It is presumed that the accompanying drawings will enable the reader to understand the forms of the experimental beams, it being remarked, that, in each case, the form was such as would be generated by giving the figure representing the cross section, a motion of translation only, along a straight line—keeping the moving area constantly perpendicular to the line of motion. The lower rectangle, *e e, f, f*, would thus generate the “lower rib,” and the upper rectangle *a a, b b*, would generate the “upper rib,” of the beam; and the rectangle, *c, d, d, c*, would generate what we shall call the vertical plate of the beam. It will be seen at once, that almost any distribution of a given quantity of material, may be effected, by merely varying the dimensions of the rectangles in constructing the pattern for the casting.

3. The arrangement, for augmenting at pleasure, the pressure upon the beam, consisted of a combination of levers—one of which being a large Roman steelyard with a scale at the extremity of the longer arm: a small weight being placed on the scale, had its effect greatly augmented by the combined multiplying effects of the levers; and this increased effect was exerted by means of a cylindrical piece of iron laid straight across the middle of the top surface of the beam; so that the pressure acted uniformly along the transverse line of the middle of the upper surface of the beam. By this arrangement a small weight could be carefully applied to the scale of the steelyard without exerting a percussive effect.

4. In every case, the beam was supported by resting each of its extremities upon a well squared piece of iron about two inches in diameter, so that before exerting any pressure upon the beam, the bearing of each extremity was about two inches; and it may be well to remark here, that, immediately after the beam felt the pressure, the extremities bore only upon the inner

edges of the supporting pieces of iron; and hence, the "distance between the points of support" in what follows, must be regarded as the perpendicular distance between the inner surfaces of said supporting pieces of iron.

5. The pressures exerted are expressed in English pounds avoirdupois; the linear dimensions are expressed in English inches and parts, and the superficies in square inches. The dimensions were measured several times and when any difference was found, a mean of the whole was taken as the final result. The drawings are all made upon a uniform scale, the top and the front views containing, of course, but a small portion of the beam in length. The depressions recorded in the tables, were measured with the utmost care.

## 6. EXPERIMENT I.

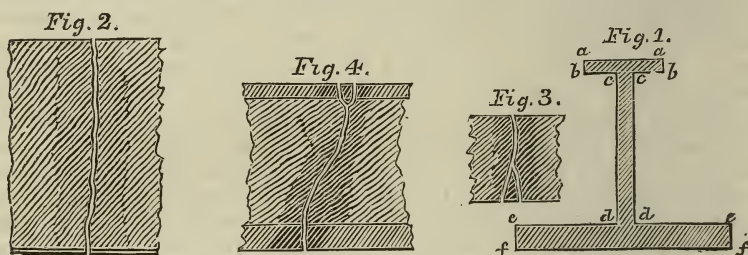


Fig. 1. represents a cross section of the beam.  
 Fig. 2. a top view of the fracture of the lower rib.  
 Fig. 3. " " " upper "  
 Fig. 4. a side view of the fracture of the beam.

### Dimensions, &c.

Depth, $a, b$ , of upper rib,	0.31 in.	Breadth $a, a$ , of upper rib,	2.36 in.
" $c, d$ , of vertical plate,	4.15	Thickness $d, d$ , of vert. plate	0.394
" $e, f$ , of lower rib,	0.66	Breadth $f, f$ , of lower rib,	6.74
total of the beam,	5.12		
Area $a, a, b, b$ , of cross section of upper rib, (in sq. in. and parts,)	0.7316		
" $c, d, d, c$ , of " of vertical plate,	1.6351		
" $e, e, f, f$ , of " of lower rib,	4.4484		
" total of " of beam,	6.8151		
Total length of beam, 60 inches; distance between points of support 54 inches; and weight of the beam 105 lbs.			

### Circumstances.

The pressure being exerted upon the top of the upper rib, the upper part of the beam experienced a compression of its particles; and the lower part an extension of its particles. Augmenting the pressure by degrees—so carefully however, as not to produce a percussive effect—the beam bent more and more as the pressure increased, until of a sudden it ruptured. The annexed table exhibits the depressions of the middle of the beam in proportion as the pressure was augmented.

Pressures upon the middle.	Depressions of the middle.
$\frac{1}{2}$ (105) = 52½ lbs.	0.00 in.
15676	0.28
17244	0.32
18028	0.34
19596	0.40
20380	0.42
21948	0.46
23516	0.52
25084	0.58
25868	Beam broke.

No indications of rupture were observed during the successive augmentations of the pressure, until the beam suddenly broke under the last pressure recorded in the table; and the whole time between the applications of the first and last pressures was nearly twenty-five minutes. The drawings faithfully exhibit the appearance of the fracture; and it will be perceived that the fracture of the top of the beam was produced by compression, and that of the bottom by extension. Dividing 25868 lbs. by 6.8151 square inches, it will be found that this beam broke under a pressure of 3796 lbs. per square inch of cross section; and an inspection of the table will show the circumstances of its resistance to flexure. It should be remarked, that this beam was cast on its side, and therefore had less strength than if it had been cast on end.

## 7. EXPERIMENT II.

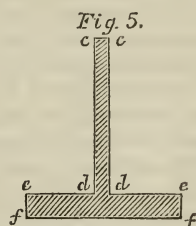
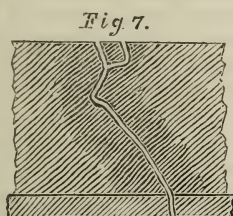
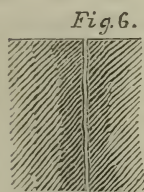


Fig. 5. represents a cross section of the beam at the place of fracture.

Fig. 6. a top view of the fracture of the lower rib.

Fig. 7. a side view of the fracture.

*Dimensions, &c.*

No upper rib,	0.00in.	
Depth <i>c, d</i> , of vertical plate	5.10	Thickness <i>c, c</i> , of vert. plate 0.46in.
“ <i>e, f</i> , of lower rib,	0.74	Breadth <i>f, f</i> , of lower rib, 5.12
“ total of beam,	5.84	
Area <i>c, c, d, d</i> , of cross section of vertical plate (in sq. in. and parts,)	2.346	
“ <i>e, e, f, f</i> , of cross section of lower rib,	“	3.7888
“ total of cross section of beam,	“	6.1348

Total length of beam 60 inches; distance between points of support 54 inches; and weight of the beam 97 lbs.

*Circumstances.*

There was no upper rib to this beam; therefore the pressure was exerted upon the top, *c, c*, of the vertical plate so as to compress the upper parts of the beam and to extend the lower parts. The pressures were augmented at intervals of a few minutes, and with all possible care to prevent percussion. The following table contains the pressures exerted, and the corresponding depressions, which were carefully noted.

Pressures upon the middle.	Depressions of the middle.
$\frac{1}{2}$ (97) = 48 $\frac{1}{2}$ lbs.	0.00 in.
15672	0.28
16456 $\frac{1}{2}$	0.28
17240	0.32
18024	0.32
18808	0.36
19592	0.38
20676	0.40
21160	0.42
21944	0.46
22728	0.48
23512	0.54
24296	Beam broke.

No signs of a rupture appeared until all of a sudden the beam broke a few seconds after the application of the greatest pressure recorded in the table: the whole time between the applications of the first and last pressures, was about thirty minutes. The drawings show, that the fracture at the top was produced by compression, and that at the bottom, by extension of the particles of the beam. Dividing 24296 by 6.1348, we obtain 3960 lbs., for the pressure per square inch, of cross section, which this form of beam sustained before breaking. The table shows the state of the flexure at the different periods of the operation, and the drawings will explain the peculiarities of the fracture. This beam was cast on end; and it will be seen, that this form sustained more, before breaking, by 164 lbs. to the square inch of section, than that of Experiment I.

## 8. EXPERIMENT III.

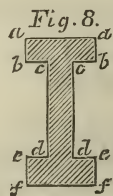
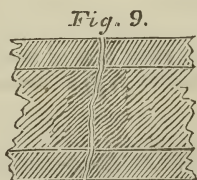


Fig. 8. is a cross section of the beam when rupture took place.

Fig. 9. a side view of the fracture. The fractures were nearly straight across the ribs.

Depth, <i>a, b</i> , of upper rib,	0.800in.		
" <i>c, d</i> , of vertical plate,	3.12	Breadth <i>a, a</i> , of upper rib,	2.42 in.
" <i>e, f</i> , of lower rib,	0.80	Thickness <i>c, c</i> , of vert. plate,	0.94
		Breadth <i>e, e</i> , of lower rib,	2.42
" total of beam,	4.72		
Area <i>a, a, b, b</i> , of cross section of upper rib, (in sq. in. and parts,)			1.9360
" <i>c, c, d, d</i> , of cross section of vertical plate,		"	2.9328
" <i>e, e, f, f</i> , of cross section of lower rib,		"	1.9360
" total of cross section of beam,		"	6.8048
Total length of the beam 60 inches; distance between points of support 54 inches; and weight of the beam 102 lbs.			

*Circumstances.*

This beam very suddenly broke under (the first pressure applied,) 15674 lbs. Indeed, it was doubtful even whether that amount of pressure had yet been fully exerted. Admitting however, that the whole pressure was felt, the beam broke under a pressure of only 2304 lbs. per square inch of cross section; and if the whole amount of pressure was not exerted, of course the beam was still less strong. This beam was cast on its side from the cupola furnace, and with no selection of metal, but all from one ladle. The sudden rupture of this beam made it impossible to measure the depressions. The drawing of the fracture would seem to indicate that it broke by extension.

EXPERIMENT IV.

9. The beam tried in this experiment, was exactly of the same form and dimensions as that of experiment II.; but it was not so good a casting. It was placed with its rib uppermost, in a manner exactly the reverse of that described in experiment II., so that the pressure was exerted upon the top surface of the rib, the beam resting with the edge of the vertical plate upon the supports; and thus causing a greater portion to experience compression, and a less portion to experience extension, than in either of the other experiments. Under these circumstances, the beam ruptured very suddenly even before the pressure arising from the apparatus of levers alone, had been brought to act fully upon the rib; thus affording a striking example of the great gain of strength, by giving a proper position to the beam with respect to the manner in which its different parts are to be strained—whether by compressing or by extending its particles.

10. Representing by 1.00 the strength of beam in experiment I., per sq. inch of cross section, the relative strengths of the different forms to resist rupture, will be expressed as follows:

Beam of the form described in Exp.	I.,	Strength to resist rupture,	1.00
Beam of	"	Exp. II.,	" " 1.04
Beam of	"	Exp. III.,	" " 0.44

By comparing the areas of the cross sections of the different forms, it will be seen that greater strength may be gained, at a less expense of metal, by giving the beam the form in experiments I. and II. instead of the form in experiment III.

All of which is respectfully submitted.

THO. JEFFERSON CRAM.

To Prof. A. D. BACHE, Univ. of Penn.

West Point, June 1836.

## NEW PATENT LAW.

We insert the law recently passed, regulating the granting of patents for useful inventions. In many of its provisions it is undoubtedly a real improvement upon the old law; there are, however, some enactments in it which we think objectionable, and others, the beneficial operation of which, may admit of much doubt. The exercise of the judicial power given to the office will require much knowledge, great prudence, and a kind and liberal feeling towards applicants, in doubtful cases. Several alterations would have been urged previously to its passage, but in the state of Congressional business a trifling opposition would have defeated it altogether, and it was thought better to break up the old system, as amendments will be more readily grafted on the new, perfection not being looked for in what is untried. We shall offer some extended remarks upon this subject at an early day.

EDITOR.

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*An act to promote the progress of useful arts, and to repeal all acts and parts of acts heretofore made for that purpose.*

Be it enacted, by the Senate and House of Representatives of the United States of America in Congress assembled, that there shall be established and attached to the Department of State, an Office to be denominated the Patent Office; the chief officer of which shall be called the Commissioner of Patents, to be appointed by the President, by and with the advice and consent of the Senate, whose duty it shall be, under the direction of the Secretary of State, to superintend, execute, and perform, all such acts and things touching and respecting the granting and issuing of patents for new and useful discoveries, inventions, and improvements, as are herein provided for, or shall hereafter be, by law, directed to be done and performed, and shall have the charge and custody of all the books, records, papers, models, machines, and all other things belonging to said Office. And said Commissioner shall receive the same compensation as is allowed by law to the Commissioner of the Indian Department, and shall be entitled to send and receive letters and packages by mail, relating to the business of the office, free of postage.

SEC. 2. *And be it further enacted,* That there shall be, in said office, an inferior officer, to be appointed by the said principal officer, with the approval of the Secretary of State, to receive an annual salary of seventeen hundred dollars, and to be called the Chief Clerk of the Patent Office; who, in all cases during the necessary absence of the Commissioner, or when said principal office shall become vacant, shall have the charge and custody of the seal, and of the records, books, papers, machines, models, and all other things belonging to the said office, and shall perform the duties of Commissioner during such vacancy. And the said Commissioner may also, with like approval, appoint an examining clerk, at an annual salary of fifteen hundred dollars; two other clerks at twelve hundred dollars each, one of whom shall be a competent draughtsman; one other clerk at one thousand dollars; a machinist at twelve hundred and fifty dollars; and a messenger at seven hundred dollars. And said Commissioner, clerks, and every other person appointed and employed in said office, shall be disqualified and interdicted from acquiring or taking, except by inheritance, during the period for which they shall hold their appointments, respectively, any right or interest, directly or indirectly, in any patent for an invention or discovery which has been, or may hereafter be, granted.

SEC. 3. *And be it further enacted*, That the said principal officer, and every other person to be appointed in the said office, shall, before he enters upon the duties of his office or appointment, make oath or affirmation, truly and faithfully to execute the trust committed to him. And the said Commissioner and the chief clerk shall also, before entering upon their duties, severally give bonds with sureties to the Treasurer of the United States, the former in the sum of ten thousand dollars, and the latter, in the sum of five thousand dollars, with condition to render a true and faithful account to him or his successor in office, quarterly, of all moneys which shall be by them respectively received for duties on patents, and for copies of records and drawings, and all other moneys received by virtue of said office.

SEC. 4. *And be it further enacted*, That the said Commissioner shall cause a seal to be made and provided for the said office, with such device as the President of the United States shall approve; and copies of any records, books, papers, or drawings, belonging to the said office, under the signature of the said Commissioner, or, when the office shall be vacant, under the signature of the chief clerk, with the said seal affixed, shall be competent evidence in all cases in which the original records, books, papers, or drawings, could be evidence. And any person making application therefor, may have certified copies of the records, drawings, and other papers deposited in said office, on paying, for the written copies, the sum of ten cents for every page of one hundred words; and for copies of drawings, the reasonable expense of making the same.

SEC. 5. *And be it further enacted*, That all patents issuing from said office shall be issued in the name of the United States, and under the seal of said office, and be signed by the Secretary of State, and countersigned by the Commissioner of said office, and shall be recorded, together with the descriptions, specifications, and drawings, in the said office, in books to be kept for that purpose. Every such patent shall contain a short description or title of the invention or discovery, correctly indicating its nature and design, and in its terms grant to the applicant or applicants, his or their heirs, administrators, executors, or assigns, for a term not exceeding fourteen years, the full and exclusive right and liberty of making, using, and vending to others to be used, the said invention or discovery, referring to the specifications for the particulars thereof, a copy of which shall be annexed to the patent, specifying what the patentee claims as his invention or discovery.

SEC. 6. *And be it further enacted*, That any person or persons having discovered or invented any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement on any art, machine, manufacture, or composition of matter, not known or used by others before his or their discovery or invention thereof, and not, at the time of his application for a patent, in public use or on sale, with his consent or allowance, as the inventor or discoverer; and shall desire to obtain an exclusive property therein, may make application in writing to the Commissioner of Patents, expressing such desire, and the Commissioner, on due proceedings had, may grant a patent therefor. But before any inventor shall receive a patent for any such new invention or discovery, he shall deliver a written description of his invention or discovery, and of the manner and process of making, constructing, using, and compounding the same, in such full, clear, and exact terms, avoiding unnecessary prolixity, as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same;

and in case of any machine, he shall fully explain the principle and the several modes in which he has contemplated the application of that principle or character by which it may be distinguished from other inventions; and shall particularly specify and point out the part, improvement, or combination, which he claims as his own invention or discovery. He shall, furthermore, accompany the whole with a drawing, or drawings, and written references, where the nature of the case admits of drawings, or with specimens of ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment, where the invention or discovery is of a composition of matter; which descriptions and drawings, signed by the inventor and attested by two witnesses, shall be filed in the patent office; and he shall moreover furnish a model of his invention, in all cases which admit of a representation by model, of a convenient size to exhibit advantageously its several parts. The applicant shall also make oath or affirmation that he does verily believe that he is the original and first inventor or discoverer of the art, machine, composition, or improvement, for which he solicits a patent, and that he does not know or believe that the same was ever before known or used; and also of what country he is a citizen; which oath or affirmation may be made before any person authorized by law to administer oaths.

SEC. 7. *And be it further enacted*, That, on the filing of any such application, description, and specification, and the payment of the duty hereinafter provided, the Commissioner shall make or cause to be made, an examination of the alleged new invention or discovery; and if, on any such examination, it shall not appear to the Commissioner that the same had been invented or discovered by any other person in this country prior to the alleged invention or discovery thereof by the applicant, or that it had been patented or described in any printed publication in this or any foreign country, or had been in public use or on sale with the applicant's consent or allowance prior to the application, if the Commissioner shall deem it to be sufficiently useful and important, it shall be his duty to issue a patent therefor. But whenever, on such examination, it shall appear to the Commissioner that the applicant was not the original and first inventor or discoverer thereof, or that any part of that which is claimed as new had before been invented or discovered, or patented, or described in any printed publication in this or any foreign country, as aforesaid, or that the description is defective and insufficient, he shall notify the applicant thereof, giving him, briefly, such information and references as may be useful in judging of the propriety of renewing his application, or of altering his specification to embrace only that part of the invention or discovery which is new. In every such case, if the applicant shall elect to withdraw his application, relinquishing his claim to the model, he shall be entitled to receive back twenty dollars, part of the duty required by this act, on filing a notice in writing of such election in the Patent Office, a copy of which, certified by the Commissioner, shall be a sufficient warrant to the Treasurer for paying back to the said applicant the said sum of twenty dollars. But if the applicant in such case shall persist in his claim for a patent, with or without any alteration of his specification, he shall be required to make oath or affirmation anew, in manner as aforesaid. And if the specification and claim shall not have been so modified as, in the opinion of the Commissioner, shall entitle the applicant to a patent, he may, on appeal, and upon request in writing, have the decision of a board of examiners, to be composed of three disinterested persons, who shall be appointed for that purpose by the Secretary of State,

one of whom at least, to be selected, if practicable and convenient, for his knowledge and skill in the particular art, manufacture, or branch of science to which the alleged invention appertains; who shall be under oath or affirmation for the faithful and impartial performance of the duty imposed upon them by said appointment. Said board shall be furnished with a certificate in writing, of the opinion and decision of the Commissioner, stating the particular grounds of his objection, and the part or parts of the invention which he considers as not entitled to be patented. And the said board shall give reasonable notice to the applicant, as well as to the Commissioner, of the time and place of their meeting, that they may have an opportunity of furnishing them with such facts and evidence as they may deem necessary to a just decision; and it shall be the duty of the Commissioner to furnish to the board of examiners such information as he may possess relative to the matter under their consideration. And on an examination and consideration of the matter by such board, it shall be in their power, or of a majority of them, to reverse the decision of the Commissioner, either in whole or in part, and their opinion being certified to the Commissioner, he shall be governed thereby, in the further proceedings to be had on such application: *Provided, however,* That before a board shall be instituted in any such case, the applicant shall pay to the credit of the Treasury, as provided in the ninth section of this act, the sum of twenty-five dollars, and each of said persons so appointed shall be entitled to receive for his services in each case, a sum not exceeding ten dollars, to be determined and paid by the Commissioner out of any moneys in his hands, which shall be in full compensation to the persons who may be so appointed, for their examination and certificate as aforesaid.

SEC. 8. *And be it further enacted,* That whenever an application shall be made for a patent, which, in the opinion of the Commissioner, would interfere with any other patent for which an application may be pending, or with any unexpired patent, which shall have been granted, it shall be the duty of the Commissioner to give notice thereof to such applicants, or patentees, as the case may be; and if either shall be dissatisfied with the decision of the Commissioner on the question of priority of right or invention, on a hearing thereof, he may appeal from such decision, on the like terms and conditions as are provided in the preceding section of this act; and the like proceedings shall be had, to determine which or whether either of the applicants is entitled to receive a patent as prayed for. But nothing in this act contained shall be construed to deprive an original and true inventor of the right to a patent for his invention, by reason of his having previously taken out letters patent therefor in a foreign country, and the same having been published, at any time within six months next preceding the filing of his specification and drawing. And whenever the applicant shall request it, the patent shall take date from the time of the filing of the specification and drawings, not however exceeding six months prior to the actual issuing of the patent, and on like request, and the payment of the duty herein required, by any applicant, his specification and drawings shall be filed in the secret archives of the office until he shall furnish the model and the patent be issued, not exceeding the term of one year, the applicant being entitled to notice of interfering applications.

SEC. 9. *And be it further enacted,* That before any application for a patent shall be considered by the Commissioner as aforesaid, the applicant, shall pay into the Treasury of the United States, or into the Patent Office,

or into any of the deposite banks to the credit of the Treasury, if he be a citizen of the United States, or an alien, and shall have been a resident in the United States for one year next preceding, and shall have made oath of his intention to become a citizen thereof, the sum of thirty dollars; if a subject of the King of Great Britain, the sum of five hundred dollars; and all other persons the sum of three hundred dollars; for which payment duplicate receipts shall be taken, one of which to be filed in the office of the Treasurer. And the moneys received into the Treasury under this act, shall constitute a fund for the payment of the salaries of the officers and clerks herein provided for, and all other expenses of the Patent Office, and to be called the patent fund.

SEC. 10. *And be it further enacted*, That where any person hath made, or shall have made, any new invention, discovery, or improvement, on account of which a patent might by virtue of this act be granted, and such person shall die before any patent shall be granted therefor, the right of applying for and obtaining such patent shall devolve on the executor or administrator of such person, in trust for the heirs at law of the deceased, in case he shall have died intestate; but if otherwise, then in trust for his devices, in as full and ample manner, and under the same conditions, limitations, and restrictions, as the same was held, or might have been claimed or enjoyed by such person in his or her lifetime; and when application for a patent shall be made by such legal representatives, the oath or affirmation provided in the sixth section of this act, shall be so varied as to be applicable to them.

SEC. 11. *And be it further enacted*, That every patent shall be assignable in law, either as to the whole interest, or any undivided part thereof, by any instrument in writing; which assignment, and also every grant and conveyance of the exclusive right under any patent, to make and use, and to grant to others to make and use, the thing patented within and throughout any specified part or portion of the United States, shall be recorded in the Patent Office within three months from the execution thereof, for which the assignee or grantee shall pay to the Commissioner the sum of three dollars.

SEC. 12. *And be it further enacted*, That any citizen of the United States, or alien, who shall have been a resident in the United States one year next preceding, and shall have made oath of his intention to become a citizen thereof, who shall have invented any new art, machine, or improvement thereof, and shall desire further time to mature the same, may, on paying to the credit of the Treasury, in manner as provided in the ninth section of this act, the sum of twenty dollars, file in the Patent Office a caveat, setting forth the design and purpose thereof, and its principal and distinguishing characteristics, and praying protection of his right, till he shall have matured his invention; which sum of twenty dollars, in case the person filing such caveat shall afterwards take out a patent for the invention therein mentioned, shall be considered a part of the sum herein required for the same. And such caveat shall be filed in the confidential archives of the office, and preserved in secrecy. And if application shall be made by any other person within one year from the time of filing such caveat, for a patent of any invention with which it may in any respect interfere, it shall be the duty of the Commissioner to deposite the description, specifications, drawings, and model, in the confidential archives of the office, and to give notice, by mail, to the person filing the caveat, of such application, who shall, within three months after receiving the notice, if he would avail himself of the benefit of his caveat, file his description, specifications, drawings,

and model; and if, in the opinion of the Commissioner, the specifications of claim interfere with each other, like proceedings may be had in all respects as are in this act provided in the case of interfering applications: *Provided, however,* That no opinion or decision of any board of examiners, under the provisions of this act, shall preclude any person interested in favor of or against the validity of any patent which has been or may hereafter be granted, from the right to contest the same in any judicial court in any action in which its validity may come in question.

SEC. 13. *And be it further enacted,* That whenever any patent which has heretofore been granted, or which shall hereafter be granted, shall be inoperative or invalid, by reason of a defective or insufficient description or specification, or by reason of the patentee claiming in his specification as his own invention, more than he had or shall have a right to claim as new, if the error has, or shall have arisen by inadvertency, accident, or mistake, and without any fraudulent or deceptive intention, it shall be lawful for the Commissioner, upon the surrender to him of such patent, and the payment of the further duty of fifteen dollars, to cause a new patent to be issued to the said inventor, for the same invention, for the residue of the period then unexpired for which the original patent was granted, in accordance with the patentee's corrected description and specification. And in case of his death, or any assignment by him made of the original patent, a similar right shall vest in his executors, administrators, or assignees. And the patent so reissued, together with the corrected description and specification, shall have the same effect and operation in law, on the trial of all actions hereafter commenced for causes subsequently accruing, as though the same had been originally filed in such corrected form, before the issuing of the original patent. And whenever the original patentee shall be desirous of adding the description and specification of any new improvement of the original invention or discovery which shall have been invented or discovered by him subsequent to the date of his patent, he may, like proceedings being had in all respects as in the case of original applications, and on the payment of fifteen dollars, as hereinbefore provided, have the same annexed to the original description and specification; and the Commissioner shall certify, on the margin of such annexed description and specification, the time of its being annexed and recorded; and the same shall thereafter have the same effect in law, to all intents and purposes as though it had been embraced in the original description and specification.

SEC. 14. *And be it further enacted,* That whenever, in any action for damages for making, using, or selling the thing whereof the exclusive right is secured by any patent heretofore granted, or by any patent which may hereafter be granted, a verdict shall be rendered for the plaintiff in such action, it shall be in the power of the court to render judgment for any sum above the amount found by such verdict as the actual damages sustained by the plaintiff, not exceeding three times the amount thereof, according to the circumstances of the case, with costs; and such damages may be recovered by action on the case, in any court of competent jurisdiction, to be brought in the name or names of the person or persons interested, whether as patentee, assignees, or as grantees of the exclusive right within and throughout a specified part of the United States.

SEC. 15. *And be it further enacted,* That the defendant in any such action shall be permitted to plead the general issue, and to give this act and any special matter in evidence, of which notice in writing may have been given to the plaintiff or his attorney, thirty days before trial, tending to

prove that the description and specification filed by plaintiff does not contain the whole truth relative to his invention or discovery, or that it contains more than is necessary to produce the described effect; which concealment or addition shall fully appear to have been made for the purpose of deceiving the public, or that the patentee was not the original and first inventor or discoverer of the thing patented, or of a substantial or material part thereof claimed as new, or that it had been described in some public work anterior to the supposed discovery thereof by the patentee, or had been in public use, or on sale with the consent and allowance of the patentee before his application for a patent, or that he had surreptitiously or unjustly obtained the patent for that which was in fact invented or discovered by another, who was using reasonable diligence in adapting and perfecting the same; or that the patentee, if an alien at the time the patent was granted, had failed and neglected for the space of eighteen months from the date of the patent, to put and continue on sale to the public, on reasonable terms, the invention or discovery for which the patent was issued; in either of which cases judgment shall be rendered for the defendant, with costs. And whenever the defendant relies in his defence on the fact of a previous invention, knowledge, or use of the thing patented, he shall state, in his notice of special matter, the names and places of residence of those whom he intends to prove to have possessed a prior knowledge of the thing, and where the same had been used: *Provided, however,* That whenever it shall satisfactorily appear that the patentee, at the time of making his application for the patent, believed himself to be the first inventor or discoverer of the thing patented, the same shall not be held to be void on account of the invention or discovery or any part thereof having been before known or used in any foreign country, it not appearing that the same or any substantial part thereof had before been patented or described in any printed publication. *And provided, also,* That whenever the plaintiff shall fail to sustain his action on the ground that in his specification of claim is embraced more than that of which he was the first inventor, if it shall appear that the defendant had used or violated any part of the invention justly and truly specified and claimed as new, it shall be in the power of the court to adjudge and award as to costs as may appear to be just and equitable.

SEC. 16. *And be it further enacted,* That whenever there shall be two interfering patents, or whenever a patent on application shall have been refused on an adverse decision of a board of examiners, on the ground that the patent applied for would interfere with an unexpired patent previously granted, any person interested in any such patent either by assignment or otherwise, in the one case, and any such applicant in the other case, may have remedy by bill in equity; and the court having cognizance thereof, on notice to adverse parties and other due proceedings had, may adjudge and declare either the patents void in the whole or in part, or inoperative and invalid in any particular part or portion of the United States, according to the interest which the parties to such suit may possess in the patent or the inventions patented, and may also adjudge that such applicant is entitled, according to the principles and provisions of this act, to have and receive a patent for his invention, as specified in his claim, or for any part thereof, as the fact of priority of right or invention, shall in any such case be made to appear. And such adjudication, if it be in favor of the right of such applicant, shall authorize the Commissioner to issue such patent, on his filing a copy of the adjudication, and otherwise complying with the requisitions of this act. *Provided, however,* That no such judgment or adjudication shall affect

the rights of any person except the parties to the action and those deriving title from or under them, subsequent to the rendition of such judgment.

SEC. 17. *And be it further enacted*, That all actions, suits, controversies, and cases arising under any law of the United States, granting or confirming to inventors the exclusive right to their inventions or discoveries, shall be originally cognizable, as well in equity as at law, by the circuit courts of the United States, or any district court, having the powers and jurisdiction of a circuit court; which courts shall have power upon bill in equity, filed by any party aggrieved, in any such case, to grant injunctions, according to the course and principles of courts of equity, to prevent the violation of the rights of any inventor as secured to him by any law of the United States, on such terms and conditions as said courts may deem reasonable: *Provided, however*, That from all judgments and decrees, from any such court, rendered in the premises, a writ of error or appeal, as the case may require, shall lie to the Supreme Court of the United States, in the same manner and under the same circumstances as is now provided by law, in other judgments and decrees of circuit courts, and in all other cases in which the court shall deem it reasonable to allow the same.

SEC. 18. *And be it further enacted*, That whenever any patentee of an invention or discovery shall desire an extension of his patent beyond the term of its limitation, he may make application therefor, in writing to the Commissioner of the Patent Office, setting forth the grounds thereof; and the Commissioner shall, on the applicant's paying the sum of forty dollars to the credit of the Treasury, as in the case of an original application for a patent, cause to be published, in one or more of the principal newspapers in the city of Washington, and in such other paper or papers as he may deem proper, published in the section of country most interested adversely to the extension of the patent, a notice of such application and of the time and place, when and where the same will be considered, that any person may appear and show cause why the extension should not be granted. And the Secretary of State, the Commissioner of the Patent Office, and the Solicitor of the Treasury, shall constitute a board to hear and decide upon the evidence produced before them both for and against the extension, and shall sit for that purpose at the time and place designated in the published notice thereof. The patentee shall furnish to said board a statement, in writing, under oath, of the ascertained value of the invention, and of his receipts and expenditures, sufficiently in detail to exhibit a true and faithful account of loss and profit in any manner accruing to him from and by reason of said invention. And if, upon a hearing of the matter, it shall appear to the full and entire satisfaction of said board, having due regard to the public interest therein, that it is just and proper that the term of the patent should be extended, by reason of the patentee, without neglect or fault on his part, having failed to obtain, from the use and sale of his invention, a reasonable remuneration for the time, ingenuity, and expense bestowed upon the same, and the introduction thereof into use, it shall be the duty of the Commissioner to renew and extend the patent, by making a certificate thereon of such extension, for the term of seven years, from and after the expiration of the first term; which certificate, with a certificate of said board of their judgment and opinion as aforesaid, shall be entered on record in the Patent Office; and thereupon the said patent shall have the same effect in law as though it had been originally granted for the term of twenty-one years. And the benefit of such renewal shall extend to assignees and grantees of the right to use the thing patented, to the extent of their

respective interest therein: *Provided, however,* That no extension of a patent shall be granted after the expiration of the term for which it was originally issued.

SEC. 19. *And be it further enacted,* That there shall be provided for the use of said office, a library of scientific works and periodical publications both foreign and American, calculated to facilitate the discharge of the duties hereby required of the chief officers therein, to be purchased under the direction of the Committee of the Library of Congress. And the sum of fifteen hundred dollars is hereby appropriated for that purpose, to be paid out of the patent fund.

SEC. 20. *And be it further enacted,* That it shall be the duty of the Commissioner to cause to be classified and arranged, in such rooms or galleries as may be provided for that purpose, in suitable cases, when necessary for their preservation, and in such manner as shall be conducive to a beneficial and favorable display thereof, the models and specimens of compositions and of fabrics and other manufactures and works of art, patented or unpatented, which have been, or shall hereafter be deposited in said office. And said rooms or galleries shall be kept open during suitable hours for public inspection.

SEC. 21. *And be it further enacted,* That all acts and parts of acts heretofore passed on this subject, be, and the same are hereby repealed: *Provided, however,* That all actions and processes in law or equity sued out prior to the passage of this act, may be prosecuted to final judgment and execution, in the same manner as though this act had not been passed, excepting and saving the application to any such action, of the provisions of the fourteenth and fifteenth sections of this act, so far as they may be applicable thereto. *And provided, also,* That all applications or petitions for patents, pending at the time of the passage of this act, in cases where the duty has been paid, shall be proceeded with and acted on in the same manner as though filed after the passage thereof.

JAMES K. POLK,

*Speaker of the House of Representatives.*

W. R. KING,

*President of the Senate, pro tempore.*

APPROVED, July 4th, 1836.

ANDREW JACKSON.

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## Physical Science.

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*History of experiments on atmospheric electricity, being a report presented by a Committee\* of the "Franklin Kite Club," at the request of the Club.*

The Committee appointed to enquire into the history of experiments, upon the electricity of the atmosphere; having given such attention to the subject as their other engagements would allow: beg leave to submit the following report :

The fact that amber and some gems, when excited by friction, possessed the curious property of attracting light bodies; was known to philosophers several centuries before the christian era. Nothing further, however,

\* John C. Cresson, Esq. Chairman.

than this simple fact, seems to have been ascertained for the space of two thousand years.

The first modern experiments upon record were those of Dr. Gilbert of Colchester, an account of which he published about the year 1600, in a treatise de magnete. Although several philosophers repeated the experiments of Gilbert, and somewhat augmented the list of electric substances, no discovery of importance was effected until about the year 1670, at which period Otto Guericke, celebrated as the inventor of the air pump, constructed the first electrical machine of which we have any account, and acquired an additional title to renown, by discovering the light and sound by which the electric fluid is accompanied.

The existence of electric light was observed shortly afterwards in England, by Dr. Wall, to whom also is due the honor of first suggesting the idea of a resemblance between electricity and lightning.

This resemblance was afterwards noticed by Mr. Stephen Gray, who flourished about the year 1730; and still later by the Abbe Nollet; but neither of them appears to have attempted any investigation of the subject. The complete solution of this interesting problem in electrical science was reserved for our venerated countryman, Franklin; who at an early period of his investigations, became strongly impressed with the idea that lightning and electricity were identical. He accordingly drew up a statement of the principal points of resemblance between them, and suggested a plan for proving the truth of his theory, by elevating pointed conductors upon a lofty tower or spire. This paper, together with several others upon the same subject, he transmitted to his friend Mr. Collinson of London, by whom they were communicated to the Royal Society.

The reception which these essays met with in that learned body was by no means flattering, as will be perceived from the following extract from Franklin's Memoirs. "Obliged as we were to Mr. Collinson, for the present of the tube, &c., I thought it right he should be informed of our success in using it, and wrote him several letters containing accounts of our experiments. He got them read in the Royal Society, where they were not at first thought worthy of so much notice as to be printed among their transactions. One paper which I wrote for Mr. Kinnorsly, on the sameness of lightning and electricity was read, but was laughed at by the connoisseurs." The papers being afterwards shown to Dr. Fothergill, he thought them of too much importance to be stifled, and advised the printing of them. They were accordingly published in a pamphlet form by Cave, a bookseller in London, with a preface by Dr. Fothergill. A copy of this pamphlet happening to fall into the hands of Buffon the naturalist, this eminent philosopher was so well satisfied of the justness of Franklin's views, that he determined on making the attempt to draw down lightning from the clouds. Accordingly, he raised an insulated rod of iron upon the tower of Montbar, and prevailed upon M. D'Alibard, to prepare an apparatus for the same purpose at Marly La Ville, about six miles from Paris. This apparatus consisted of a pointed iron rod, about forty feet long and an inch in diameter, the lower extremity of which was brought into a sentry box and insulated upon a table with glass feet. M. D'Alibard entrusted the charge of his apparatus to a man named Coiffier, who having served fourteen years in the dragoons, was supposed to have sufficient courage for such an undertaking.

We have been thus particular in our description of this machine, because it was the first to receive a visit from the ethereal fire; and shall now pro-

ceed to give a narrative of that important event, extracted from a paper laid before the Royal Academy of Science, at Paris, three days after the occurrence. "On Wednesday, the 10th of May, 1752, between two and three o'clock in the afternoon, M. Coiffier, an old dragoon, whom I had entrusted to make observations in my absence, hearing a pretty loud clap of thunder immediately flies to the machine, taking with him a vial in which was fixed a brass wire; on presenting the point of the wire to the rod he sees a small brilliant spark issue from it, and hears a crackling noise; he takes a second spark stronger than the first and with a louder noise! He calls his neighbors and sends for M. Raulet, the Prior of Marly. The Prior runs with all his might, and the parishioners seeing his haste imagine that poor Coiffier had been killed by the thunder; the alarm spread throughout the village, and the hail which succeeded did not prevent them from following their Pastor.

The honest ecclesiastic arrived at the machine, and seeing there was no danger, tries the experiment himself, and takes some strong sparks. The hail storm was not more than a quarter of an hour in passing the zenith of our machine and there was no more thunder after the first clap." As soon as the cloud had passed and they could get no more sparks from the rod, the Prior despatched M. Coiffier with the following hasty letter.

"I announce to you sir, the fulfilment of your expectations; the experiment is complete. This day, at twenty minutes after two in the afternoon, it thundered directly over Marly, the clap was pretty loud. The desire to please you, and curiosity, induced me at once to quit my arm chair, in which I was engaged reading. I was hastening to M. Coiffier, and met on the road a child whom he had despatched to call me, I redoubled my speed through a torrent of hail. Arriving at the spot where the rod was placed, I took a brass wire and advancing it towards the rod, when within about an inch and a half, a small column of blueish flame with a smell like sulphur, sprung with wonderful quickness to the point of the wire, and occasioned a noise as if the rod had been struck with a key. I repeated the experiment at least six times in about five minutes, each experiment requiring about the time of a Pater and an Ave. I wished to continue them but the action of the fire gradually abated, and at length ceased altogether. The stroke of thunder which had occasioned this event was not followed by any other and the whole was terminated by a copious shower of hail.

I was so engaged during the experiment, that receiving a blow upon my arm above the elbow, I could not tell whether it proceeded from the brass wire or the rod. I did not complain at the moment, but the pain continuing on returning home, I uncovered my arm in the presence of Coiffier, and we perceived a contusion around it, such as would be caused by a blow from the wire upon the bare skin. When returning with Coiffier, I met the Curate, M. de Milley and the schoolmaster, to whom I reported what had happened. They all three perceived a smell of sulphur, which increased as they approached me: this odour was also perceived by the servants before I said any thing to them about it.

You have here, sir, a hasty recital, but it is correct and true, and I assure you that I am prepared to testify to these facts on all occasions. Coiffier was the first to make the experiment, and he repeated it several times before he sent for me. If any other testimony besides his and mine is necessary you can obtain it. Coiffier is in haste to depart. I am yours with respectful consideration.

RAULET, *Prior of Marly.*"

May 10, 1753.

Immediately upon the announcement of M. D'Alibard's success, M. Delor demonstrator of physick, at Paris, erected a bar of iron upon his dwelling for the purpose of repeating the experiment, and succeeded in procuring several sparks during a thunder storm on the 18th day of May. On the 19th of the same month, Buffon obtained a similar result at Montbar.

Thus was Franklin's hypothesis verified in Europe, while its illustrious author was waiting for the erection of a spire at Philadelphia, by which he should be enabled to reach what he supposed to be the proper region for experiment. At length he devised the simple expedient of using a common kite for the attainment of his object, and in June, 1752, about a month after the French discoveries, but before any report of them had reached America, he performed his celebrated experiment.

Although it may seem unnecessary to repeat in this place a narrative with which every school boy is familiar, we shall, nevertheless, annex an account of this famous experiment, believing the omission would leave our report defective in a very essential point. The kite used by Franklin on this occasion, was made by extending a silk handkerchief upon two crossed sticks. To the upright stick was affixed an iron point.

The string was of hemp, except a small portion of the lower end, which was of silk: where the hempen string terminated a key was fastened. With this apparatus, on the approach of a thunder storm, he repaired to an open field accompanied by his son, to whom alone he had communicated his intention.

Having raised his kite, he placed himself under a shed, to avoid the rain and preserve the insulation of his silk cord. A thunder cloud passed over the kite and no sign of electricity appeared. When, almost despairing of success, he observed the loose fibres of the string become erect as if they were repelled. He now presented his knuckle to the key and received a strong spark; others succeeded even before the string was wet; but when the string was thoroughly wetted by the rain, he collected the electric fire in great abundance.

Franklin afterwards erected an insulated rod upon his house, by means of which he continued to investigate the subject for several years, in conjunction with his friend Mr. Kinnersly. The new field of discovery thus opened to the votaries of science, was speedily entered by a host of experimenters. Of these, it will be necessary to name only a few of the more prominent, whose experiments and discoveries embrace all that it is interesting to know.

In England, the first attempts to repeat these experiments, were made by Mr. Canton and Dr. Bevis; but owing to the unfavorable nature of the climate, or some defect in their apparatus, it was not until after numerous disappointments that they succeeded in obtaining some feeble indication of electricity. The most splendid experiments that have come under the notice of the Committee, were those made in France by M. De Romas, assessor of the Presidial of Nerac.\* This gentleman made use of a kite which was seven feet five inches in height, and three feet in its greatest width, having above eighteen square feet of surface. The string was wrapped with copper wire somewhat after the manner of the base string of a violin.

On the 7th of June, 1753, at one o'clock, it thundered in the west; at

\* A full account of these experiments may be found in the *Memoirs de Savans Etrangers*, published by the French Academy.

half past two M. De Romas, had raised his kite with a cord 780 feet long, inclined at an angle of  $45^{\circ}$  nearly; so that the elevation of the kite was about 550 feet. To the lower end of the cord he tied a ribbon of silk about three and a half feet long; this was brought under cover of a pent house and was there fastened to a heavy stone. Near the junction of the cord and ribbon was suspended a tube of tin one foot long and an inch in diameter, from which the sparks were to be drawn.

He had prepared a discharging rod with a glass handle twelve inches long, and provided with a brass chain of sufficient length to touch the ground when sparks were drawn from the tube. By means of the discharging rod he at first obtained sparks as large as those produced by a good globe, and several of his assistants drew sparks with keys and with the naked finger. This performance continued about twenty-two minutes, when the electricity disappeared; the little black clouds from which it was procured having passed from the zenith of the kite. In about seven minutes the electricity re-appeared, but was at first very feeble; it gradually increased, and sparks were drawn by the fingers, canes, and swords, of the spectators. M. De Romas now touched the tube with his knuckle, and received a terrible shock, such as he had never experienced from the Leyden vial charged by the best globes. Seven or eight of the bystanders having joined hands received sparks which struck the feet of the fifth person. The storm now approached and increased in violence, not a drop of rain had fallen; but in the zenith of the kite and about  $60^{\circ}$  around it, there were black clouds, which indicated a great increase of electricity.

M. De Romas therefore, thought proper to receive sparks only by the discharge; and in this manner drew several sparks more than two inches long and of proportionate thickness. After this, the electricity became so strong, that instead of sparks sheets of fire three inches long and three lines in diameter, flashed to the distance of more than a foot from the tube. At this time, when about three feet from the cord, he felt a sensation as if a spider's web was upon his face. He advised his assistants to keep at a greater distance, and himself retired about two feet; and when five feet from the cord, he again perceived the same sensation and retired still further. M. De Romas now paused to observe what took place in the clouds above the kite; there was no lightning, almost no thunder, and not any rain, the wind was west and so strong that the kite rose about 100 feet higher than at first. Having cast his eyes upon the tin tube which was about three feet from the ground; he observed three straws about a foot long, and others four and five inches in length, standing erect upon the ground and dancing in a ring beneath the tube like puppets. This little spectacle lasted about fifteen minutes, after which some drops of rain fell and he again felt the spider web sensation, and heard a rustling noise like the sound of a small forge bellows. This was considered a warning of a new increase of electricity, and he cautioned his assistants to retire to a greater distance. Now came the last act of this magnificent drama, which M. De Romas says made him tremble. The longest straw was attracted by the tube, and then followed an explosion which some compared to the noise of a petard, and others to the sound of a large earthen jar dashed upon a pavement. The fire which accompanied this explosion had the form of a spindle eight inches long and four or five lines in diameter. The straw which had caused the explosion followed the string of the kite and was seen at the distance of forty or fifty toises going with great rapidity, alternately attracted and repelled, every attraction being accompanied by sheets of fire

and continual explosions. During this part of the exhibition there was a strong smell of sulphur, and around the string there appeared a cylinder of permanent light three or four inches in diameter; which, it was supposed, would have appeared to be four or five feet in diameter if the experiment had been made at night. Shortly after this the wind shifted to the east and the rain fell abundantly, followed by some hail, so that they were unable to keep the kite up any longer; as it fell the string came in contact with a roof; the kite was made to rise again, and as soon as it was released from the roof the person who held the string received such a violent blow in his hands that he was compelled to relinquish it. The string now became slack and falling upon the feet of one of the assistants, he felt a concussion almost insupportable. On the 16th of August, 1757, M. De Romas, having again raised his kite with a cord more than 1000 feet in length, obtained results even more astonishing than those just narrated.

In a letter to the Abbé Nollet, giving an account of this experiment, he says, "imagine to yourself sheets of fire nine or ten feet in length, and one inch in diameter, with a noise like the report of a pistol: in less than an hour I had certainly thirty flashes of these dimensions without counting a thousand others of seven feet and under."

The dangerous nature of these experiments was fearfully illustrated about this time, by an accident which created a deep sensation throughout the scientific world. Prof. Richman, of St. Petersburg, being engaged in a treatise upon electricity, had erected upon his house an apparatus for observing the electrical condition of the atmosphere, during thunder storms. On the 6th of August, 1753, while attending the usual meeting of the Imperial Academy of Sciences, a little before noon he heard the sound of distant thunder, and hastened home accompanied by Mr. Sokolow, engraver to the Academy. Upon examining the electrometer which was attached to his apparatus, Richman remarked that the thread pointed to four degrees on the quadrant; and described to Mr. Sokolow, the dangerous consequences that might ensue if the electricity should increase to  $45^{\circ}$  or more. At this moment while Mr. Richman was in a stooping posture with his head about a foot distant from the rod, a globe of white and blue fire about the size of a man's fist appeared between the machine and Mr. Richman's head.

At the same time a sort of steam or vapour arose which stupefied the engraver and made him sink down, so that he could not remember to have heard the thunder which was very loud.

As soon as Mrs. Richman heard the loud clap of thunder she hastened to her husband's chamber, fearful of some bad consequences, and found him entirely lifeless, sitting upon a chest which happened to be placed behind him, and leaning against the wall.

After this unfortunate occurrence, electricians became more circumspect in experimenting upon an agent so dangerous and intractable. The phenomena of thunder storms having been investigated to a considerable extent, philosophers next directed their attention to observations upon the ordinary electrical condition of the atmosphere and the changes to which it is subject. Experiments of this kind were prosecuted in America, by Mr. Kennersley, the friend and associate of Franklin; in France by M. Le Monnier, and the Abbé Mazeas; in Switzerland by M. De Saussure; and in England by Mr. Cavallo, Mr. Read, and several others. But the labours of these philosophers although of great value and interest, fall very far short of those achieved by Signior Beccaria, of Turin; who continued a series of accurate experiments through a period of twenty years.

The observations of this eminent philosopher, were made in all kinds of weather and every season of the year. He made use of a great variety of instruments, and employed numerous assistants, sometimes causing simultaneous observations to be made at several distant places. As the limits of this report will not allow a detailed account of the phenomena observed by all these philosophers, it is deemed advisable to furnish a condensed statement of the general results, upon which most of the observers agree in a very satisfactory manner.

In calm, clear, dry weather, the electricity was always perceptible and invariably positive. It was more abundant in winter than in summer. During a rain it was generally negative, but it sometimes became positive while the rain was falling; and on some occasions these changes occurred several times in the course of a single storm.

In cloudy, damp, or windy weather, it was mostly positive but feeble. The quantity always increased with the length and elevation of the conductor; insulated strings extended horizontally, sometimes gave strong indications of electricity; a cord 1,500 Paris feet in length, extended across the river Po, was found to be as strongly electrified during a shower unattended by thunder, as a rod of metal had been during a thunder storm.

The latest of these experiments were made about the year 1791; since which period the interesting phenomena brought to light by the discovery of galvanism, have so much engrossed the attention of philosophers, that the other branches of electrical science have been comparatively neglected.

As far as the committee have been able to extend their researches, it appears that the observers of atmospheric electricity, have confined their experiments to a region of comparatively very small elevation, none of them having attained a greater distance from the surface of the earth, than one thousand feet; and even the few who reached this height, made use of such imperfect conductors, as were not calculated to furnish accurate results. It therefore seems probable, that a course of experiments made with good conductors elevated to the height of ten or fifteen thousand feet, would furnish such an addition to our knowledge of this interesting subject, as would fully compensate the labour and expense necessary for their prosecution.

*Notice of the "Report on the new map of Maryland, 1835."*

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

SIR:—I send to you for insertion in the Journal of the Franklin Institute, a notice of the report of the gentlemen appointed under a law of Maryland, to make a Topographical and Geological survey of that state. The examination has manifestly been confided to able hands, and I think sir, that you will concur with me in the conclusion that the course adopted by Prof. Ducatel, in devoting so large a portion of investigations and observations in the first instance, to those deposits and formations which may be at once available by the cultivator of the soil, is, in every point of view, most judicious.

The state of Maryland has been among the first of the Union to adopt the liberal and enlightened policy, which there is now good ground to hope will become general. The report for 1835, is the third which has been made since the commencement of the survey of Maryland, and it will be seen that she will be in possession of an exact description of her surface, topographically as well as an examination into the constituents of her soil geologically, by which her resources will be developed, and her geographical limits and positions be determined. The construction of her new topographical and

geological map was commenced, and has been continued under the direction of J. H. Alexander, Esq. and Prof. J. T. Ducatel of the University of Maryland, the former having charge of the topographical, and the latter the geographical department. The report whose title stands at the head of this notice, was submitted to the Governor of the state during the last winter, and embraces a detail of the progress of the work during last year. It exhibits industry and intelligence, combined with the requisite scientific attainments for an exact and useful survey, and does credit to the already well established characters of the gentlemen engaged in its execution. The report is divided into two separate and distinct papers, each emanating from the respective officers, and treating exclusively of the matters peculiarly referred to his charge. That of the topographer, is chiefly occupied with details of local surveys, to which his attention had been especially directed by resolutions of the legislature, relative to the opening of new avenues of internal communication, the draining of marshes, &c. &c. and although it may possess but little to attract the general reader, it is interesting in the highest degree to the citizens of Maryland. The grand trigonometrical survey of the state has also occupied his attention, and details are exhibited showing its progress, under the advice of the chief of the United States Coast Survey, in connexion with which, this work is designed to be executed;—reciprocal benefits being anticipated from this mode of prosecuting the work. Several well executed lithographic maps accompany the report, illustrating particular portions of it. The concluding pages of the report recommending the establishment of a state observatory is particularly deserving of general perusal; the cause of science, and of public utility, would be promoted by a general attention to the following considerations presented in their remarks on that subject.

"After what has been said, the undersigned might terminate here his report, were it not that an object of great interest remains still to be submitted to your Excellency. This is a provision for the erection of a *State Observatory*. Although not indispensably necessary for the proper completion of the trigonometrical survey, it would furnish great and evident assistance, and would be found to increase in utility and value in proportion as the establishment itself grew older, long after the period when the labours of that survey shall have been closed. The fact of the importance of astronomical observations in one place, under the same circumstances, with assured regularity, and in a proper series, need not be adverted to here. The first advances towards civilization and the sciences were in the rude attempts to collect and classify knowledge in this particular—their latest acmé will be illustrated by the efforts and success in its pursuit. Already, in Europe, the *moral force* of a government is estimated by what is done under its auspices to enlarge the sphere of acquaintance with facts: and if for us the prosperity of the present is no inducement, a pledge of the gratitude of the future is found in the affectionate reverence with which the memory of those especially, who in this branch toiled, under greater disadvantages, for the promotion of the very object here recommended.

The Undersigned solicits, then, the particular attention of your Excellency and of the General Assembly, to this proposition. He asks for it no more aid, of course, than its intrinsic worth seems to deserve: but it appears to him that, to every one who will take the trouble to make the comparison, the contrast between the amount expended and benefits gained will be very striking. Not many hundred dollars would be required to arrange the necessary apparatus, with the conveniences, for its earliest trials. The fruits

of ten years' labour in that observatory would *sell* (if it is to keep a profit and loss account,) for five times so much—at the same time that it is exercising a moral influence incalculably more valuable.

The fact, that in this country there has been as yet no establishment of this kind, and that extensively indebted as our commerce is to the laborious investigations and observations of citizens and governments abroad, no effort has yet been made towards repayment, appears to offer strong grounds for the measure; and the present crisis seems not unfavourable for its execution. It may be added, that by no member of our national confederacy can the step be with more propriety taken than by Maryland; who has already, within late years, done so much by a discreet liberality to foster not only the researches of pure science, but that happier union of science and enterprize, which alone will render the one valuable—the other not unavailing."

A better index to what has been done by the geologist during the same period cannot, perhaps be furnished than by inserting the following extract from the report itself.

"It will be remembered that the final intention of the survey is, to furnish to the officer now engaged in preparing a topographical and geographical map of the state, on the accomplishment of his work, with a complete and minute geological account of the whole state, which will enable him to indicate upon the new map the localities of valuable mineral deposits, as well as to exhibit correctly, the limits of the different geological formations, that compose the territory of Maryland. Accordingly, the undersigned has never lost sight of this final object of his investigations, so that it has been his constant care to collect as much information in this respect as possible: and he flatters himself that he has succeeded in acquiring all the knowledge desirable, of such portions of the state as have been already traversed, and over which geological surveys have been completed. But it cannot be expected of him to make those results fully known at present, because there remains another important step to be taken, namely: to connect the results of observations made in one section of the country, with those in another; by which many generalities of consequence may be extended, corrected, improved, or modified. It is not necessary to be conversant with the subject, to perceive the necessity of becoming well acquainted with every part of a system of formations, before any comprehensive description of such a system can be given. Nor has it been in the power of the geologist, to adopt and pursue such a plan of operations more in accordance than the one he has followed, with this apparently most desirable mode of proceeding; his instructions having been virtually, to cause the strict demands of science to yield to the paramount considerations of public favour and utility. Hence it has not unfrequently happened, that whilst pursuing with great personal interest, a series of observations, a sense of public duty, and a desire to render more immediately available some important suggestion, have compelled him to obey calls upon him to set on foot new inquiries in other districts. Thus, whilst endeavouring to determine the exact limits of the three tertiary periods that occur within our territory, and partly extend over both shores of the Chesapeake bay, having received specimens of a valuable material, forming part of the secondary formations, it was deemed advisable to repair to this new field of interest, to expedite the benefit that might be derived from the discovery: some advantage being moreover expected, by directing the researches of those interested in it, preparatory to the future more minute investigations."

The report appears fully to establish the existence of green land of the age of the New Jersey marl, in Kent and Cecil counties, and intimates that some of the members of the same formation have been discovered in the Potomac counties.

In the belief that the legislature which ordered the survey designed it as the means for developing all the advantages and riches of the state for the benefit of every portion of her population, the geologist in prosecuting his labours, has endeavoured to embrace in his report every prominent consideration of practical utility immediately or remotely applicable, to the various interests of his fellow citizens.

In accordance with this understanding of his duties, he has laboured and it would seem successfully, in demonstrating to the agriculturists of Maryland, that they have within their reach the means of fertilizing and improving their soil to any desirable extent. Shell marl, green sand, oyster shell lime, are all readily attainable in their respective localities, whilst the unusual facilities of transportation afforded by the Chesapeake Bay and its numerous tributaries and inlets, afford to the farmers of both its shores, advantages, which are seldom equalled, and probably nowhere surpassed.

The cultivators of the soil are, it is said, already beginning to avail themselves of what has been pointed out in the former reports, and, if so, their practical experience will soon corroborate the scientific intelligence, which pointed out to them the sources of abundance and wealth so directly at their command.

One whole chapter of the report is occupied with considerations upon the agricultural resources of the lower counties, which is too voluminous for insertion in your pages; I therefore extract the following very interesting summary of them, intended by the author to direct the attention of his fellow citizens to the greater advantages which present themselves in their own fair territory, than may be found in the "far west" whither the restless spirit of emigration is fast hurrying a great amount of the population.

"Such are the agricultural resources of the lower counties on the eastern shore of Maryland, so far as the productiveness of the soil, and its susceptibility of improvement are concerned. It has already been stated, that the only incidental resource possessed by this section of country, is to be derived from the facilities of obtaining calcareous matter (in which the soil is essentially deficient) from the shell banks, oyster banks, and other sources already referred to. But before any hope can be indulged, that the inhabitants of this portion of the state will avail themselves of these means of bringing their lands into a higher state of cultivation than they seem to have any idea that they are capable of, it is necessary to remove a fatal impression, too generally made, that the lime derived from shells is of but little value. The result of the inquiries made to disprove this opinion, will be given in the next section of this report.

An error equally fatal prevails among the citizens of Maryland, in reference to the counties that have just been passed in review,—that they are as devoid of interest as they have been believed to be of resources. It is hoped that the minute, and, at the same time, faithful account given of them—more minute than would otherwise have seemed necessary—will have a tendency to rectify the false judgment so commonly passed upon this portion of our territory, and contribute likewise to cheer those of its inhabitants who have become disheartened at the present aspect of things, and who are too prone to believe that their industry could be better rewarded at a distance."

The immense heaps of oyster shells, furnishing vast supplies of lime, has induced Prof. Ducatel to devote an entire chapter, to a comparison of the value of shell and stone lime—an opinion prevalent among Maryland farmers that the former was inferior, for agricultural purposes, to the latter, is satisfactorily refuted. The analysis of the respective kinds of lime, showed a decided advantage in the employment of *equal weights* of lime obtained from calcined shells, over that obtained from limestone.

The annexed extract furnishes a general summary of the comparison; it is preceded by a particular account of the analysis of ten specimens of limestone, from Baltimore, Harford, and Frederick counties.

“It will be perceived that three out of the ten are magnesian limestones; all of them contain more silica or sand than has been found in oyster shells, and one, said to be most extensively used in Harford county, contains as much as eleven per cent. of inert matter. It follows, therefore, that, as oyster shells are composed nearly of pure carbonate of lime, they will afford a lime containing scarcely an appreciable quantity of impurities. If well burnt, (which is the case when no effervescence is observed on treating them with a weak acid,) lime obtained from them may be deemed, with a fractional difference, equal, weight for weight, to the best stone lime; and as their chemical composition does not vary, there is nothing to be deducted from the value of the product in consequence of the impurities that exist, as exhibited by the foregoing table, in most limestones, and that must necessarily form a part of the residue when *these* are burnt.

If the comparative value of the two products be estimated by measure, a greater difference is discovered; but there is at the same time a disproportionate difference in price. A bushel of the best alum-lime weighs from ninety to a hundred pounds; whereas, the same bulk of shell lime, unground, weighs from sixty-five to seventy five pounds, and perhaps when ground would weigh eighty pounds,—a difference of from twenty to twenty-five per cent. But the former costs from thirty to thirty-five cents at Baltimore, the most convenient spot for its delivery on tide-water, where the latter can be had for ten cents; whilst farmers, conveniently situated on the bay side, might themselves burn the shells at an expence not exceeding six cents a bushel. These remarks refer to the lime obtained from recent or fresh oyster shells; but there is little or no difference between it and that procured by the burning of those contained in the Indian shell banks, provided proper care be taken to separate them from the black mould and dirt with which they are mixed.

It has been supposed, that because alum-lime has been found to admit of a greater admixture of sand than shell lime, in the making of mortar, it was to be inferred that it is correspondingly better, or, as it is termed, *stronger* for agricultural purposes. But this is an unwarrantable conclusion; for, as this circumstance seems to depend upon the peculiar aggregation among the particles of the lime, which prevents it from *setting* too rapidly, (or, in other words, attracting water and carbonic acid from the atmosphere sooner than the wants of the mason require.) it would appear, on the contrary, that, if any inference is to be drawn from it, it is adverse to the conclusion; whilst, on the other hand, the fact that shell lime *sets very quickly* is favourable to the opinion, entertained by some persons, of its superior efficacy in agriculture,—it being generally understood that lime acts in the soil in the condition of carbonate of lime. Admitting, however, that the peculiar arrangement of the particles in stone lime which renders it in general coarser than the lime obtained from shells, may better fit it as a mechanical amendment

to certain soils, the difference is at most as one to three, according to the datum upon which its superiority is predicated; namely, that in the preparation of mortar, stone lime will bear three times as much sand as shell lime. But even in this respect the conclusion is not warranted, except perhaps in the case of a purely sandy soil, in which lime *alone* would, it is believed, prove of little service."

The discovery of green sand, forms an important epoch in the agricultural history of the state, on account of its value as a manure; and a considerable space is devoted to its consideration. The author combats the opinion expressed in the Farmer's Register, that the fertilizing properties of this marl, are due to the sulphate of lime which it contains, and attributes them, with much reason, to the potassa found by analysis to exist in it, adapting thus, the conclusion of Prof. H. D. Rogers, in regard to the Jersey green sand. The geologists account of this interesting formation,, as well as that of the *micaceous black sand* associated with it, will well reward a careful perusal.

The greater portion of the report is occupied with an examination of the three lower counties of the eastern shore of Maryland, but there is a chapter containing a "Geological examination of St. Mary's county, in reference to its agricultural resources"—and a number of localities of shell marl or fossiliferous deposits are pointed out which may be made available. The gypseous clay mentioned in the first report, is also alluded to as doubtlessly affording a valuable agricultural resource. In addition to the marl, St. Mary's county also possesses the Indian shell banks, already referred to as existing in the Eastern Shore counties.

Under the title "Progress of the Geological survey of the State" the geologist, gives a detailed account of the extent of country visited by him during his tour of duty. Twelve of the nineteen counties of the state have been visited, and six of them, it is said, thoroughly examined so far as the purposes of the survey appear to require.

It is believed that this brief sketch of the contents of the report, will suffice to justify the assertion made at the commencement of this notice, that the industry, skill, and scientific attainments of the gentlemen employed by the state of Maryland, are such as eminently qualify them to execute the task which they have undertaken. And should the citizens of that state duly appreciate and employ the resources at their command, prosperity and wealth will abound in situations where the soil has been hitherto deemed as of but little value; the same rich treasures being within their reach which were so long unknown in the state of New Jersey, and which, since their value has been known, has caused the wilderness to blossom as the rose.

It appears from information which may be relied on, that the able manner in which Prof. Ducatel has discharged his duty, and the judicious construction which he has placed upon the intentions of the legislature, have already much more than repaid the expenses which have or will attend the examination. Lands have risen in value, new products are beginning to be obtained from the soil, and instead of exhausting its fertility by continued cultivation, without the attempt at renewing it, the means pointed out have been resorted to, by which it may regain its original vigour, and even the "old fields" again become laden with harvests. From present indications, it appears almost certain that the splendid schemes of Internal Improvements, now projected by the state of Maryland, will be carried into operation at a very early day, thus affording the means of communication throughout the larger portion of her territory. The fruits of the husbandman's labour, and

the mineral treasures from the mine, with which she appears to be liberally supplied, will thus find a ready market. And we may fairly hope that when the blessings which must result from such improvements are fully experienced, it will not be forgotten that a large debt of gratitude will be due to those branches of science, without whose aid the hidden treasure would never have been brought into view; and that a flourishing community will, in its turn, contribute liberally to their further advancement.

A FRIEND TO INTERNAL IMPROVEMENT.

*Note by the Editor.*—We had read with much pleasure the Report which forms the subject of the foregoing notice, and had marked for abstract and insertion in the Journal, most of the passages quoted by our correspondent, which we should have accompanied with such remarks as might have appeared to us pertinent; we, however, have preferred to avail ourselves of the labours of others, which, we believe, will also be equally acceptable to our readers.

*Note on the occurrence of Bituminous Coal near the city of Havana, in Cuba; by R. C. TAYLOR, Mining Engineer.*

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN:—I observe with much interest the notice of your correspondent, in the last number of the Journal of the Franklin Institute (p. 375) of a plan for extensively working the beds of bituminous coal in Illinois. There is little doubt but that an abundant supply of coal, of the quality he describes, will be of great public utility in the South,—will supersede, for many purposes, the employment of other fuel;—and will have a widely extended market, even down to New Orleans, to the great private advantage also, I trust, of those who are preparing to put this undertaking in execution.

I do not think, however, that the Illinois coal will form a large article of export, to the Havana for instance, as your correspondent suggests. *The existence of extensive veins of coal within the tropics is now established.* Probably it is not yet generally known, that there have been recent discoveries of coal, of very extraordinary quality, at at least two points on the coast of Cuba, near the Havana. One of these is only three leagues from that city, and two miles from the sea at a place of embarkation. This mine has very recently been investigated by Mr. Clemson and myself, and forms the subject of a joint report to the proprietors, on the quality, quantity, and mode of working it efficiently.

I do not enter into a description of this singular coal, because we are preparing a separate communication for a scientific institution.

It is extremely probable that this coal, which contains so remarkable a proportion of bitumen, will be exported from the Havana to most of the ports on the southern extremity of this continent.

I may add that coal occurs near the north-east end of Jamaica. Mr. De la Beche informs me, however, that these coal seams are very thin, and that none of sufficient magnitude to render them worth working have been discovered.

I am, gentlemen, respectfully,

Philadelphia, July 13, 1836.

RICHARD C. TAYLOR.

## Franklin Institute.

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### COMMITTEE ON SCIENCE AND THE ARTS.

#### *Report on Messrs. Garrett and Eastwick's Locomotive Steam Engines.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, the Locomotive Engines made by Messrs. Garrett and Eastwick,  
REPORT:—

That they have examined one of these engines now in progress of construction, at the shop of Messrs. Garrett and Eastwick, and witnessed the performance of another which has been completed and placed on the Philadelphia and Trenton Rail Road for trial.

They are constructed upon the principle of outside connections, the general arrangement being similar to that adopted by Mr. M. W. Baldwin, with some modifications, however, of sufficient importance to give them a distinct and original character. The most striking peculiarity is in the manner of reversing. This operation is performed in the different engines heretofore in use, by various contrivances, all of which involve the necessity of ungearing the connection of the eccentric rods with the rock shafts: consequently their action depends upon the contingency of throwing these parts again into gear, which can be effected only at particular points in the revolution of the eccentrics.

In the engines under consideration, the reversing is performed by means of movable valve seats, which are placed between the slides and the true seats, and connected with hand levers by rods passing through stuffing boxes in the steam chest.

In each movable seat are five passages, four of which are steam ways and one for the exhaust; two of the steam ways and the exhaust opening pass directly through the seat, the other two steam ways pass only about one-third through, and communicate with chambers which form oblique passages from one end of the seat to the other, so that the steam which enters the upper opening at one end of the seat, escapes by the lower opening at the opposite end.

When the movable seat is so adjusted that the direct passages coincide with the openings in the true seat, the action of the valve is similar to the common short slide: but if the seat be shifted, so that the communication shall be through the oblique passages, the course of the steam to the cylinder will be reversed without any change in the motion of the slide. This arrangement possesses the merit of simplicity in a high degree, and as its action does not depend upon any contingency, the engine can be reversed with certainty and precision. A small loss of steam results from the increased thickness of the valve seat, but it is believed the amount will not be sufficient to produce any appreciable effect upon the power of the engine. It has been suggested that the inequality of wear to which the movable seat will be subjected in its different positions, must render its surface irregular, and impair the tightness of the valve; some inconvenience may arise from this source, the extent of which can be determined only by experience; it is not apprehended, however, that the evil will be of a serious nature.

The situation of the cylinders and driving wheels in engines, with outside connections, allows a leverage to the working strain which very much increases the wear between the driving axles and their boxes, and also

twists the frame out of its proper form. Messrs. Garrett and Eastwick have endeavored to guard against the injury resulting from this cause by some slight changes in the parts most exposed to its effects.

Instead of turning down the bearings of the driving axle to obtain a shoulder for preventing lateral motion in the axle, they leave the axle its full size throughout, and provide against lateral motion by facing the hubs of the wheels, so as to form shoulders which bear against the outer ends of the boxes. The increased extent of bearing surface which is thus obtained both within the boxes and at their ends, enables them to resist more effectually, the thrust of the engine and adds to their durability.

The firmness of the whole machine has been increased by bracing the cylinders to the fire box, and bolting to the under side of the frame a strong plate of iron, which passes entirely around it and is secured to the pull bar.

The Committee have been informed that the engine which is upon the Trenton Road, has given entire satisfaction during a trial of several weeks constant service; the exhibition of its performance witnessed by them was highly gratifying, and they feel themselves warranted in saying that these engines afford evidence of ability to manufacture locomotives equal to any in the country for excellence of workmanship and general finish.

By order of the committee.

July 14, 1836.

WILLIAM HAMILTON, *Actuary*.

#### *Report on Mr. Prutzman's Lever Lock and Key.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, the Lever Lock and Key, invented by Mr. Prutzman of Philadelphia, REPORT:—

That they have examined the lock and key and find it to be a specimen of both *ingenuity and workmanship*.

The main feature in the lock is the manner of securing the bolt, so as to prevent its being operated on by means of a *pick*, and to prevent a key being fitted to it unless in detached parts. The lock is arranged with tumblers working vertically, and horizontally, so as to secure the bolt in its position, when locked or unlocked. The tumblers are operated on by means of a lever inserted in the bit of the key, and working on a centre. This lever is put in motion by a plate so arranged in the lock, as to pass into one of the wards of the key, and press the lever towards the barrel or stem. One end of this lever acts on a projection raised on one of the tumblers, causing it to descend, whilst a portion of the key acts on a parallel tumbler, causing it to ascend, the opposite end of the lever acts on a horizontal tumbler, and thereby relieves the bolt. When the bolt is shut the tumblers resume their former position and secure it in its place. A lever is placed between the two parallel tumblers and working on a centre, the bolt is secured at one end and moved by means of a key at the other causing the bolt to move in an opposite direction to that of the key.

The general arrangement of the lock is simple and good, and we may add the best that is within the knowledge of the Committee. From the common key an impression may be taken so as to form a duplicate, but from the present arrangement of a key, with a lever inserted, it will not be practicable, owing to the great accuracy required in the formation of the lever.

Mr. Prutzman deserves a great deal of credit for his *ingenuity*. The

Committee understand that several of the locks are at present in use; one in the banking house of the U. S. Bank, and others in the city of Baltimore. The Committee recommend it to the public, particularly to Bank directors.

By order of the committee.

May 12, 1836.

WILLIAM HAMILTON, *Actuary.*

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*Report on Mr. Raub's Steam Gauge.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, Mr. Raub's Steam Gauge, REPORT:—

That Mr. Raub's Steam Gauge consists of a safety valve or piston, differing in no essential feature from ordinary safety valves, except that there is connected with it, by means of a lever, a weight, suspended in the water of the boiler, in such manner that when the water gets below a certain point, at which the weight is placed, the increased power of the weight, arising from its losing the support of the water, assists in opening the safety valve.

The practical effect is this:—If the safety valve is so graduated that steam will be blown off at a certain pressure, say seventy-five pounds to the inch, when the boiler is properly filled with water, it will escape at a lower pressure, say fifty or sixty pounds to the inch, according to the dimensions of the weight, when the water is too low. In this way it is proposed to avoid the explosions, or other evil effects which might arise from a portion of the boiler becoming bare of water and heated to a high degree.

The principle on which the weight acts, is like that of the floats which have been heretofore used, to show the height of water in the boiler, except that the weight in Mr. Raub's machine is connected with the ordinary safety valve, and the steam is blown off in large quantities when the water is too low, instead of a simple alarm being sounded.

The question for the consideration of the Committee is whether this combination, is advantageous. It is a matter of doubt, whether the blowing off of a quantity of steam when the water is deficient in the boiler, is not pernicious, as tending still more to exhaust the water; and whether the old application of the float to regulate the supply of water is not better. Waving these questions, however, it appears evident to the Committee that if a weight or float is to be used to cause the escape of steam, when the water is too low, it is better to have it attached to a separate valve, instead of being connected with the ordinary safety valve; because on the latter plan it will not operate when the steam is at a low density or pressure, although the water be deficient; and because when it does operate, the engineer cannot know whether its action is in consequence of the water being too low, or the steam too high. Hence the advantages usually anticipated from the use of floats, cannot be realized from this machine.

Whether floats or weights can safely be relied on for showing the low state of the water in the boiler, and for obviating its effects, is a question of experience which it is unnecessary here to discuss, inasmuch as Mr. Raub does not claim to have originated them, but to have made an improvement in their application: and for the reasons above stated, the Committee are not satisfied that his steam gauge, in its present form, will be found practically advantageous.

By order of the committee.

May 12, 1836.

WILLIAM HAMILTON, *Actuary.*

VOL. XVIII.—No. 3.—SEPTEMBER, 1836.

## Mechanics' Register.

### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1836.

*With Remarks and Exemplifications by the Editor.*

1. For a *Machine for peeling Apples and Peaches*; J. W. Hatcher, Bedford county, Virginia, February 3.

This, we believe, is the sixth peeling machine that has been patented, and we do not think it any improvement upon the first, which was that of Moses Coates, obtained in 1803. The one before us, has a spindle, with a fork to receive the apple, a second spindle with an endless screw, a cog wheel, pinion, whirl and band, and other appendages for moving the knife; the apparatus for moving the knife is the only part claimed.

2. For a *Cooking Stove*; J. R. Cochran, Francestown, Hillsborough county, New Hampshire, February 3.

There is nothing in this stove worthy of special notice, its virtues depending upon the particular arrangement of the passages for heated air, and the dampers or valves. The claims are to "the form and construction of the apertures for the passage of the fire, and the dampers for closing either of them, or the passage under the oven, and the division of the passages for fire, by partitions, whereby the whole volume of fire is thrown on one side of the stove, and a greater heat thus produced on that side, and various degrees are produced in different parts of the stove at the same time, suitable for the different processes of cooking, and with less fuel than in any other stove of equal dimensions." As one object professed to be attained in a new cooking stove is, in nearly every case, to save fuel, we shall, by the time we have another five hundred stoves patented, not only save the whole, but have some to spare, should each of them save a little upwards of one five hundredth part only.

3. For an improvement in the art of *Manufacturing Rope and Cordage*; William Fanning, city of New York, February 3. (See specification.)

4. For a *Cooking Stove*; Daniel Williams, Scaghticoke, Rensselaer county, New York, February 3.

This stove resembles, in form, a number of other cast-iron cooking stoves, having a body nearly rectangular, a fire place furnished with folding doors, an oven similarly furnished above it, and openings towards the back of the top plate, for cooking utensils. Its claim to novelty consists in making the fire place a sliding drawer, which can be brought forward upon the bottom plate; this drawer has a grate upon which the fuel is sustained, and a top plate, perforated for cooking utensils. When pushed in, there is, necessarily, a double plate between the fire and the interior of the oven.

The claims are to the movable, sliding fire place, the manner of connecting it with the other parts of the stove, and particularly to the obtain-

ing by its means, a double bottom to the oven, and thereby regulating the intensity of the heat; the provisions for carrying off the steam, &c.

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5. For an improvement in the *Cultivator*; James W. Garnet, Loretto, Essex county, Virginia, February 3.

This is called an improvement on the X, or Echelon Cultivator. "It consists of a curved cast-iron, marked No. 3, having in the under side two dovetail grooves, which the wrought iron marked No. 4, [shown in the drawing] is made to fit, so that when one point is worn out the other may be turned. Four of these are fixed in a bar of wood diagonally, at an angle of  $45^{\circ}$ , to a straight beam of the length and size of a common plough beam for a single horse."

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6. For a *Machine for Shelling Corn*; Isaac A. Hedges, Elmira, Tioga county, New York, February 3.

This machine, in its general principles, resembles the first shelling machine which was patented. It has a revolving cylinder and a concave, between which the ears of corn are to be shelled. The cylinder is to be formed of cast-iron staves, having teeth upon it, and the concave is also of cast-iron staves, with spaces between them for the escape of the grains of corn; the concave is borne up by springs. The ears are to be put into a hopper above the cylinder, and to be conducted through a proper aperture to the shelling part. The claim is to "the concave cylindrical surface by a combination of staves, with springs attached as herein described; and the application of such surface so formed to the purposes of corn shelling; as also the application of such surface to a cylinder for the same purpose."

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7. For an *Oven to be used over the common Fire Place*; Samuel Pollard, Orono, Penobscot county, Maine, February 3.

This patent is taken for an improvement upon the oven patented by the same person in June, 1835, and noticed at page 46, vol. XVII. The sheet-iron oven is placed, as before, across the chimney, above its throat, and in addition to the flue leading to it, about level with the surface of the fire, there is a second flue near the throat of the chimney, which is closed by a door. A grate is fixed in the flue to sustain fuel, that a fire may be lighted there when there is none in the fire place. The claim is to "the introduction of the second described flue, damper, and grate; the outside cylinder and the damper above, or on the top of it, these being the additions now made, as improvements." The second cylinder forms the flue around the oven, and is like that in common use in similar ovens set in jambs.

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8. For an improvement in *Saw Mills*; George W. Black, Montgomery county, Tennessee, February 3.

The object in constructing this mill is to apply the power above the surface of the ground. The main cog wheel, driven by any suitable power, gears into a pinion on a pitman shaft above the sills, the pitman extending thence to a rocking shaft which gives motion to the saw frame, hung in the usual way. The claim is to the horizontal pitman and its appurtenances, including "the entire mode of driving the saw, or saws, and the mode of applying the power to them," in which the patentee perceives numerous

advantages, which we apprehend will not be realized in many situations, and no where, assuredly, where water power is employed.

9. For a *Straw Cutter*; Isaac S. Wright, Elbridge, Onondaga county, New York, February 3. (See specification.)

10. For a *Machine for Harvesting, Thrashing, and Cleaning Grain*; Eliakim Briggs and George W. Carpenter, Covington, Franklin county, New York, February 5.

This machine is to run on four wheels, like wagon wheels, the adhesion of the hind wheels to the ground carrying revolving scythes, a cylinder thrashing machine, and other appurtenances. The apparatus is not fully described, and we are very apprehensive that it had not been fairly tried before being patented, as we are of opinion that its promise upon paper would not be realized in the wheat field. Its power to cut, convey, thrash, and clean grain, and the satisfactory concurrent action of all its parts, would not, we think, have given it a passport to the Patent Office.

The claim is to "the manner and principles of applying the power of a team to cutting, thrashing, and cleaning grain, by moving forward the machine; of cutting grain, of carrying it to the thrasher, of thrashing, and of cleaning grain, by power so applied." This claim does not, with sufficient distinctness, state the particular machinery for effecting the object, refers to no individual part of it, but appears to relate more to the end than to the means, whilst the latter is the only thing patentable.

11. For an improved *Saddle Tree*; Andrew R. McBride, Williamson county, Tennessee, February 5.

This saddle tree is to be made of four pieces of wood only. The crotch or front piece is to be formed from the natural growth of the timber. The cantle is also to be a single piece, and these are to be connected by the two side pieces. Whether the crotch is to be made from a crotch, or how the natural growth is to be obtained, we do not learn, nor are the directions given, in general, specific in their character; the claim is entirely omitted, and we are left, therefore, to infer, for ourselves, what it is intended to patent.

12. For a *Horse Rake for Hay and Grain*; Joseph W. Webb, Mount Morris, Livingston county, New York, February 5.

Behind an axletree with two wheels, there is a frame which sustains the rake-frame, and the latter slides up and down between cheeks, furnished with grooves for that purpose; upon the bottom edge of the rake-frame are teeth, curved forward and reaching to the ground; a man stationed on a platform above the axle tree, raises the rake-frame by means of a lever, when it has collected the desired quantity, and thus deposits it. The points of the rake teeth curve back suddenly to prevent their catching in the ground. The claim is to "the manner of raising or depressing the rake at pleasure, by means of the perpendicular grooves and the lever; and the manner of curving the teeth backwards, for the purpose set forth."

13. For a *Machine for cleaning smut from Buckwheat and Rice*; Samuel Richardson, Elmira, Tioga county, New York, February 5.

It is very well that the patentee sets forth no exclusive claim to this ma-

chine, as, were he to do so, he would encounter a host of competitors. The whole consists of a hollow cast-iron cone, in which runs a conical nut, both properly grooved, in the well known old coffee mill fashion.

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14. For a *Press for Cotton, Tobacco, &c.*; Azel M. McLean, Russellville, Logan county, Kentucky, February 5.

This press consists of a lever working on a fulcrum between two upright posts, the articles to be pressed being placed under the lever, and resting on sills, or a platform on the ground. A rack and pinion below the long end of the lever serves to raise or lower it; and the improvement claimed consists in extending the lever beyond the uprights, so that it shall have a short arm projecting out far enough to press the articles by the elevation of the long arm, as they are pressed on the opposite side by its depression.

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15. For a *Horse Power*; Dudley Marvin, Canandaigua, Ontario county, New York, February 5.

This machine is, in its general construction, like many which have preceded it, consisting of an endless chain floor upon which the animal walks, which floor is sustained by friction rollers running upon ways, and connected so as to form endless chains; it is the peculiar manner in which these are put together, upon which the patentee must depend to sustain a claim, and he says, "I confine my claim to the particular manner in which I construct the power chain, and the friction chain, as described, together with their combination with those accessory parts which are necessary to their action. I do not claim either of the individual parts as separate and uncombined."

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16. For a *Churn*; Hezekiah Roberts, Seneca Falls, Seneca county, New York, February 5.

A vertical churn is to have the dasher made to revolve alternately in reversed directions, by means of a double strap, the two ends of which are wound round the shaft, and are alternately acted upon. To produce this motion, the patentee employs a wheel and pinion, on the shaft of the latter of which there is a crank and fly wheel. A pitman from the crank is made to vibrate a wheel which communicates the alternating revolution by means of the straps. The claim is to "the crank, connecting rod, spur wheel, pinion, and balance wheel." All of which are well known affairs.

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17. For an improvement in the *Process of preparing bark and obtaining the extract therefrom*; Daniel Williams, Boston, Massachusetts, February 5.

We are informed that the bark is to be first divested of its outer part, after which the inner bark is to be cut into small pieces, and the tanning principle extracted therefrom by boiling, or by steam; the water is then evaporated and the extract fit for use. The thing claimed is the extracting tannin from the inner bark cut into pieces, instead of grinding or pulverizing it, by which means, it is said, the extract is more pure, being free from the admixture of the minute particles which remain in it when procured from the ground material.

How many thousand times the chemist has thus obtained the extract of bark in his laboratory, we cannot tell, but certainly more frequently than from the pulverized material.

18. For an improvement in the *Cotton Saw Gin*; William and James M'Creight, Winnsborough, Fairfield district, South Carolina, February 5.

The gin retains its usual form, but the patentees claim, "First, a movable breast; second, sliding ribs, and third, the centres of the brush, and the pivots on which they turn," which improvements, they say, render the apparatus more durable, and more easily kept in order.

"The breast is hung to the front of the gin with two hinges, and can always be raised so as to get at the saws," when they require any attention. The sliding ribs are so called, because they are made so as to shift, or slide, and expose new portions of them to the action of the seed, so that they may be shifted endwise four or five times, before they require to be renewed; they are confined at their ends by screwed cleats, which are loosened when the ribs are to be shifted. The pivots of the brush are made of square cast-steel, pointed at each end, and fixed in a manner which allows of their being shifted readily when one end is worn.

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19. For an improvement upon a *Grist Mill*; William and James M'Creight, Winnsborough, Fairfield district, South Carolina, February 5.

This is said to be an improvement upon the grist mill, patented by Ed. Newman, in February, 1827.

The improvement consists in the lengthening of the spindle to twice the original amount, and in the mode of fixing and regulating the hard wood bushes which bear against it. We do not think it necessary to particularize the mode of fixing the hard wood for this purpose, but will merely say that the bush consists of four pieces, standing endwise against the spindle, confined in their places, and regulated in their bearing, by means of screws.

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20. For an improvement in *Locomotive Steam Engines*; Henry R. Campbell, Northern Liberties, Philadelphia county, Pennsylvania, February 5.

"My improvement consists in the combination and application to each locomotive steam engine, of two pair of driving or propelling wheels, and two pair of guide wheels. I also claim as a modification, and as a part of my improvement, the combination and application to each locomotive steam engine, of two pairs of driving or propelling wheels, and one pair of guide wheels. What I denominate *guide wheels*, are those which carry a portion of the weight of the engine and conduct it along the rail road, without direct connexion with the driving wheels."

The objects in view are to increase the weight and power of the engine; to extend its bearing and weight over a larger portion of the road; to increase the adhesion by doubling the number of driving wheels; "to increase the facility of turning curves by compounding the leverage of the engine upon the flanches of the wheels against the edges of the rails;" to reduce the wear and tear, and consequently the expense of transportation on rail-roads.

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21. For a *Bee Hive*; James W. Hubbard, Canterbury, Merrimac county, New Hampshire, February 5.

There is not any thing in the contrivance of this hive which appears to

merit particular notice, the thing claimed is a mere trifling matter of arrangement.

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22. For *Flasks for moulding hollow bulge Ware*; Lewis H. Maus, Danville, Columbia county, Pennsylvania, February 5.

At page 60 of the last volume, we published the specification of a patent obtained by David Stewart of Danville, under a title, and for a purpose, similar to the foregoing. We have not had time to compare the two plans with all that care which is necessary to enable us to point out their resemblances and differences, but our present impression is, that they are substantially the same. In the former case there is a distinct claim made, pointing out the particulars of the improvement, as may be seen by turning to the specification; in that before us, certain peculiarities in the plan pursued are spoken of, but there is not any formal claim, although one may probably be made out by construction. We shall probably publish Mr. Maus' specification hereafter.

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23. For a *Thrashing Machine*; Lewis H. Maus, Danville, Columbia county, Pennsylvania, February 5.

This is said to be an improvement on James Parson's thrashing machine. The cylinder and concave are to be of cast-iron, and the improvement appears to consist in the casting it in parts more light and convenient than the original machine; there, however, is no specific claim, nor is there any thing in the operation of the machine, as now patented, to distinguish it from other cylinder and concave thrashing machines.

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24. For an improvement in the *Saw Mill Saw*; Benjamin K. Barber, Johnsburgh, Warren county, New York, February 5.

Two teeth in the middle of the saw are to be set in a winding position, and are to be ground "to an edge on the outside, so that the upper outer edge of the teeth shall be sharp, and stand out on each side of the saw more than even with the outside edge of the points of the other teeth, when set about half as wide as is usual for common sawing." There is also to be a kind of tooth attached to the back of the saw, and set in a winding position, so as to cut up on one side and down on the other. We confess that we do not fully comprehend the description, nor do we see how teeth in the centre of a saw are to operate on stuff to be sawed which is wider than the double length of the crank; a kind of stuff not unfrequently cut. There is no claim, and we do not know that one is required, as the whole thing may be new.

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25. For a mode of *Equalizing the blood of the human system*; Solomon R. Terrell, Burton, Yazoo county, Mississippi, February 5.

The arm, leg, or whole body, is to be enclosed in a tube, or vessel, rendered air tight by India rubber, or other suitable substance, and the air is then to be extracted by means of an air pump, so as to take off atmospheric pressure from the part enclosed, and thereby cause an influx of blood; to promote which additional warmth is to be applied. This is the sum and substance of the patent. About thirty years ago a patent was obtained in England for a similar apparatus, and an agent came into this country to carry the plan into effect here. It was intended not only to exhaust the air as above proposed, but to admit steam or gases, to act upon the limb or

other part, enclosed. We repeatedly saw the instruments in Philadelphia, but after the lapse of three or four months heard no more of them.

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26. For an improvement in *Mortise and other Locks*; Philos and Eli W. Blake, New Haven, Connecticut, February 5.

This lock exhibits much ingenuity and skill in its construction, but the description and drawing would both be necessary to make the plan adequately known. There are eight specific claims, which if given alone, would not afford an idea of the structure; we must therefore pass it over, as requiring more space for illustration than can be afforded.

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27. For *Preventing the heating of Flour and Meal in Grinding*; Isaiah Pape, Windham, Cumberland county, Maine, February 5.

A strap of leather is to be buckled, or otherwise fastened, round, and near the lower edge of the upper stone or runner; and to this are attached fifteen, or any other preferred number of blocks, or pieces of iron, which hang loosely upon the edge of the bed stone; these are to prevent the flour accumulating between the stones and curb, and remove it, consequently, from the source of heat.

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28. For *Preventing malt liquors from becoming sour*; Josiah Stowell, Manchester, Hillsborough county, New Hampshire. (See specification.)

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29. For a *Crimping Form, for crimping boots*; William Gerrish, Poland, Cumberland county, Maine, February 10.

The form, with the screws and nuts by which the leather is to be drawn on to it, are fully described, but there is no claim made, or any attempt to discriminate between this and the numerous other contrivances for the same purpose.

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30. For an improvement in *Gun Locks*; Samuel Morrison, Milton, Northumberland county, Pennsylvania, February 10.

One object in this lock is to enable the gunner to fire off either one or two loads at the same time, or at separate times, from a single barrel. The first load is received in a chamber somewhat smaller than the general bore of the gun, and the charge is covered by its ball, after which the second load is rammed down; there must be two cups for percussion powder, or nipples for two caps, with a contrivance to prevent the discharge of the first charge, when one only is to be fired off. There are six separate claims to distinct parts of the lock and its appendages, which we do not think it necessary to give. It has been repeatedly proposed to place several charges in a single barrel, to be fired in succession, and the mode of effecting it has been described, but there, we believe, the matter has ended, and is likely again to end.

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31. For a *Twain Water Wheel*; William L. Elgar, Chester county, New Hampshire, February 10.

Here are to be two shafts each having buckets, or floats, at one end, and geared together at the other by cog wheels. The water is to be "applied at the centre, so as to exert its power on both," and the claim made is to

"the applying the two wheels together, thereby obtaining a much greater power from the same quantity of water."

We are not instructed in the manner of causing the water to act upon the floats in the centre only, and we really cannot tell how it is to be effected; the thing, however, is altogether unworthy of thought.

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32. For a machine for *Planing and Dressing Boards*; Melzer Twells, Milo, Yates county, New York, February 10.

A fare wheel is to revolve vertically, carrying four, or any other number of, plane irons, and close to the periphery are to be cutting bits, or hooks, to precede the double or single irons in their operation. The boards are to be held edgewise, resting against standards upon a suitable carriage, and held against the vertical standards by dogs. The plane wheel is to be driven by one band and whirl, and the carriage to be moved by another. This comprises all the information given, and there is not any claim. The plan has nothing in it having the remotest alliance to novelty, nor does it bear those features of maturity which would lead to the conclusion that it had been tried. The fact, is that as presented in the specification, it will not work well, and if it would, a patent could not be sustained for it.

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33. For a *Machine for Shelling Corn*; Henry G. Neale, Poultney, Rutland county, Vermont, February 10.

A rubbing board, furnished with teeth, or cased with a toothed cast-iron plate, is made to slide horizontally in grooves, by means of a handle, a second rubbing board being placed under it, and borne up towards it by steel or wooden springs attached to the frame. The claim is to the whole machine as constructed.

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34. For a *Machine for cutting Straw, Hay, &c. &c.*; Chauncy D. Skinner and Dana Reed, Haddam, Middlesex county, Connecticut, February 10.

The specification of this patent gives a verbose description of the dimensions of the different parts of the machine, and ends by claiming "the combination of the various parts as described." The material to be cut is placed in a trough in the usual way, and the knife is fixed upon the face of a wheel revolving vertically; the shaft of this wheel has a crank on it, and is to be driven by the aid of a treadle, in the manner of a foot lathe. There is no feeding apparatus, or any thing of moment not pointed out by us.

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35. For a *Churn*; Lyman Whittier, Vienna, Kennebec county, Maine, February 10.

A churn, in the ordinary form of the vertical kind, is so hung as to swing backwards and forwards like a pendulum, there being a suitable frame to sustain it. A vertical shaft passes through the top, and runs in a pivot at the bottom of the churn; wings, or dashers, being attached to it to agitate the cream. A small cog wheel, or pinion, surrounds the vertical shaft, above the lid of the churn, and the teeth of this wheel take into teeth on a piece of timber, forming a rack, and attached to the frame, which, when the churn is swung, causes the shaft to revolve; the swinging may be effected by means of a rod, or other contrivance, attached to it for that purpose. The claim is to the mode of producing motion by the action of the cogs.

36. For a *Machine for Cutting Straw*; Joseph Evered, an alien, who has resided two years in the United States, February 10.

The description of this machine refers to the drawing throughout, and ends with a claim to "the finger wheels; the rising and falling of the rollers; the compression produced by the lever and weight; the concavity of the knives edges; the plan of the face of the wheel through which the straw is drawn; the centre screw on the worm and spindle, and its rise." The general form of the machine is such as has been in use for more than half a century, the straw being contained in a trough, furnished with fluted feeding rollers, and the cutting effected by curved knives on the arms of a fly wheel, revolving at one end of the box; these curved knives, it will be seen, are claimed as new; if the inventor could go back as far as we can in the recollection of the use of curved knives, in a manner precisely the same with their employment in this machine, he would not place *himself* among the novelties of the day. There are other things claimed, which are in the same predicament, and where so many individual things are particularized, it is not easy to avoid such an error, as few persons are fully informed of what has previously been done in those cases where machines have been long employed, as in cutting straw.

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37. For a *Thrashing Machine*; Thomas Beede, Sandwich, Stafford county, New Hampshire, February 10.

This is a cylinder and concave machine, with some peculiarities about it upon which to found a claim, but not substantially different from numerous others of the same general construction.

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38. For a *Cooking Stove*; John J. Giraud, Baltimore, Maryland, February 5.

The main improvement spoken of in the specification of this stove, is a *box door*, which is to answer the purpose of the ordinary *Dutch oven*, but what are the peculiarities of its construction we cannot discover, as it is mentioned in the specification in the most general way. There is a drawing, with letters on the respective parts, but we find no references to them, and most of the things represented have no novelty whatever. The claim is to "the door oven at the front of the fire place, as well as the general combination and structure of the entire instrument." The *door oven*, which is specially claimed, is to be dispensed with when the stove is used for warming only.

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39. For an improved *Molasses Gate*; Charles W. Perkham, New Haven, Connecticut, February 10.

This gate is constructed like those in general use, but a spring is used to press the gate, or sliding plate, against the orifice of the instrument, and the employment of the spring, exclusively, is the subject of the claim.

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40. For an improvement in the *Flyer for twisting roping, and yarn of cotton, hemp, or flax*; Willard T. Eddy, Ithaca, Tompkins county, New York, February 10.

The claim made is to "the combination, arrangement, and adaptation of the several parts of the spindle and flyer for twisting roping; but particularly the mode of hanging the spindles on a joint, and securing it by a spring; also the spring bearing against the end of the spool." The par-

ticulars referred to cannot well be described without the aid of the drawing.

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41. For a *Slide Valve for Steam Engines*; Alexander M'Causland, Jr. City of Philadelphia, February 10.

This valve is constructed with a view to easy action, and facility of reversing the motion; the description refers throughout to the drawing; the claim is to "the opening through the valve, thus admitting the steam to act equally, and at once, upon the lid, or upper plate of the steam chest; and also the manner described of packing the top of the valve with metallic packing."

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42. For a *Crane for moving heavy bodies*; Elias Marsh, Oswego, Oswego county, New York, February 10.

In this crane the power is applied to a horizontal lever attached to a vertical shaft, in the manner of the common horse mill. At the upper end of this shaft there is a drum, round which the hoisting rope is to coil. The other end of the rope extends to the outer extremity of the arm of a common crane, and leads over pulleys in the ordinary way, to a block. Over the shaft of the crane there are two guide pulleys for the hoisting rope, keeping it in its place as the crane is turned in any direction. The drum at the upper end of the first named shaft, turns upon an iron gudgeon, and rests upon a coupling box, so that when the load has been raised, and the crane is turned to the point where it is to be dumped, by pulling on a lever the drum is disengaged from the coupling box, and the load descends. The claims are to "the arrangement by which the arm is left free to traverse whilst the force is operating, or by which the force applied is made to act and react in the direction of the arm, without the intervention of check ropes, windlasses, &c., attached to the boom, as in ordinary use." So far as this applies to the allowing the crane to turn freely whilst the hoisting rope is kept in its place by the guide pulleys, there is no novelty in the thing, and it seems to us as though this was mainly alluded to.

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43. For an improvement in *Piano Fortes*; John Pethick, City of New York, February 12.

The improvements claimed relate to the *action* of the instrument, and consist in "making the *breast*, and *lip*, or *notch* of the *hammer butt*, or *knuckle*, about double the thickness of those heretofore made; to wit, of the same breadth as the *hinge butt*, or a trifle less, to admit of its moving freely without chaffing each other;" to accomplish this, the shape of the hinge butt is altered, in a way described and shown in the drawings, and allowing "more than the usual width of the cloth, or other soft and suitable substance, for the centre pin to work on. In preserving the full breadth of the *Jack flyer*, or connecting lever, instead of passing it down to a breadth corresponding with that of the *hammer teeth*, as heretofore practised." These improvements are upon the French, or grand action, invented by Papp, of Paris.

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44. For *Constructing Boats to be used under water*; Edward P. Fitzpatrick, Mount Morris, Livingston county, New York, February 12.

These boats are to be constructed with a triangular cross section, one angle forming the lower point, or keel; the stem and stern are to be sloped

from the lower angle to the upper side, but they are to be, otherwise, perfectly straight. These boats are to be connected together, and to be entirely submersed; of course they must be air-tight. Pillars from them are to support a platform above the water, upon which the load is to be placed. Upon the lower side of this platform there are to be semi-cylindrical hollow trunks. "The intention of these semi-cylinders is to preserve the equilibrium of the platform, or receiving vessel, when in motion, and when the hollow triangular boats are sufficiently sunk." The propelling is to be effected by means of a paddle wheel, or of a spiral screw, placed between the boats. The claim is to "the form and construction, as being better suited to the purpose intended, of preventing the agitation of the surface in so great a degree as has been the case heretofore."

Those who have been in the habit of using Nicholson's Hydrometer, will not need to be told of the difficulty, we might say impossibility, of regulating the load of such a boat; but independently of this the whole plan is open to numerous valid objections, and proceeds upon the false assumption that the water may be agitated just below the surface, whilst it remains comparatively tranquil there.

45. For a *Churn*; John E. Thomas, Winchester, Preble county, Ohio, February 12.

The body of the churn is to be a box, or case, through which two shafts are to run, furnished with slats, or dashers, passing between each other; on the outer end of each shaft there is to be a pinion, which is to be turned by a cog wheel; numerous examples of this churn exist in the patent office, and probably elsewhere.

46. For a *Horse Power*; Joseph Austin, Franklin county, Vermont, February 12.

No claim is made by the patentee to the construction of this horse power and although such an omission is sometimes to be regretted, it, in the present instance, will not be productive of the slightest loss or inconvenience, a claim having been made thereto more than forty-one years ago, and a drawing and description of it having been given in the second volume of the Repertory of Arts, published in 1795. The plan is to obtain power by placing the animal near the top of a large, revolving drum.

47. For a *Machine for Cleaning and Dressing Feathers*; Daniel K. Hall, City of New York, February 12.

Feather dressing machines are now the order of the day, and have become so numerous as to prevent our looking after any thing new, in a new patent, excepting merely a change of form, whilst the principle of action is identical. We find no cause, in the example before us, to alter these views.

The feathers are to be put into a cylindrical screen which may be formed of wire, with solid ends. A shaft furnished with pins to agitate the feathers passes through, and may be made to revolve in, this screen. When charged with feathers it is to run upon ways into a chamber, or oven, in which it is to be enclosed by a door, admitting the shaft to pass through it. The heated air from a stove, and the vapour of water from a vessel placed upon it, aided by the agitation of the feathers, effect the purpose intended. There is not any claim made.

48. For *Securing the Drop Doors of Rail Road Cars*; John K. Smith, Port Clinton, Schuylkill county, Pennsylvania, February 12.

This is not an affair which will interest many of our readers, nor one which could be intelligibly placed before them without the drawings; the claim being "to the various pieces which compose the fastening, and their general arrangement."

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49. For a *Steam Feather Dresser*; Samuel Keplinger, City of Baltimore, February 12.

The feathers are to be put into a cylinder, similar to that described at No. 87, provided with a shaft and agitators, also similar. A second cylinder is to surround the first, at a distance of two or three inches from it; and into this steam is to be admitted from a boiler. The claim is made to "the combination, arrangement, and adaptation of the several parts of the before described machine." A standing claim which fits equally on to every contrivance, be the same old or new; but to this is added "particularly the mode of heating the feathers *by steam*, in the manner described."

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50. For a *Washing Machine*; Luther Davison, Norwich, New London county, Connecticut, February 12.

A cylinder, the ends of which may be of wood, and the barrel part of zinc, is to revolve horizontally; round bars of wood are to reach from head to head, on its inside, standing at a small distance from its periphery, and allowing a space between each of them. A partition is also to extend across the middle of the cylinder, formed of similar bars, and dividing it into two equal parts. A door on the side of the cylinder allows the clothes to be put into either division of it.

"What I claim, is the arrangement of the bars in said cylinder, the partition of the cylinder, and the principle of washing the clothes in two separate parts of the same." A *principle*, the discovery of which will scarcely confer immortality.

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51. For *Apparatus for Drying Cotton after it has been picked, &c.*; John Philbrick, Wilkinson county, Mississippi, February 12. (See Specification.)

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52. For a *Blowpipe for Furnaces*; John Barker, City of Baltimore, February 12.

The patent for this blowpipe, is about to be re-issued under an amended specification, which we shall give at length.

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53. For a *Sliding Coal Grate*; John C. Howard, Howard's Valley, Windham county, Connecticut, February 13.

A cast-iron grate, upon which a fire may be made, is to run in and out upon ways, on the sides of a fire place. The description of the thing is very imperfect, but a claim is made to "the manner of constructing this grate and its appendages, so as to be passed in and out of the chimney back, fire frame, or stove." Sliding, or "rail way grates," are no novelties, there, however, may be some unperceived advantages in the plan intended to be described.

54. For a *Machine for Shelling Corn*; Ira Smith, Downingtown, Chester county, Pennsylvania, February 13.

This machine does its work by means of a vertical revolving plate, constructed in the well known way of making such plates. The supposed novelty will appear from the claim, which is to "putting teeth or projections on both sides of the wheel, instead of on one side, as in the common method, thereby shelling twice as fast." It so happens, however, that this contrivance is old, having been patented some years since, and subsequently re-invented more than once.

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55. For a *Machine for making Screws*; William Keone, Monroe, Orange county, New York.

This machine is for cutting the threads upon wood screws; it is contrived with considerable ingenuity, and possesses much originality; it appears likely to operate well, and should it do so, and make screws with sufficient speed, it will be of great value; from want of the latter property, several such machines, in other respects very perfect, have been abandoned. The dies in this machine consist of two cast-steel wheels, about an inch and a half in diameter, fixed so as to revolve on axes, with their edges nearly in contact; upon these edges the female screw is cut. They are so constructed as to be borne up towards each other, whilst the screw is being cut, and they, and the apparatus to which they are attached, are contained within a can, or vessel, filled with oil and water. A hollow vertical shaft passes through the bottom of the vessel, and through this shaft the requisite revolving motion is communicated. The contrivances to effect this, and the other requisite objects, are too complex for verbal description. The claim is "to the combination and arrangement of the several parts of the machine for making screws, particularly the mode of giving the dies a simultaneous horizontal and vertical movement in oil and water, whilst cutting the screw." We do not think the former part of this claim sufficiently guarded, as the combination and arrangement may be much varied, whilst the result will be the same, and the means substantially similar.

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56. For an improvement in the *Wheat Fan*; David Flanders and Calender Rathburn, Fort Covington, Franklin county, New York, February 13.

The general construction of this wheat fan is the same as those in common use, and although much pains have been taken to describe its individual parts, we are not told, and are unable to discover, in what its special utility and novelty consist.

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57. For a *Machine for Cutting Sausage Meat*; Ambrose Henkel, Shenandoah county, Virginia, February 13.

The general construction of this machine may be inferred from the claim to "a cylinder with knives; secondly, their cutting between bars of any kind; and thirdly, the general construction of the machine." This claim is much too broad, the two first items in it not being sustained by their novelty, and not, therefore, sustaining the third.

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58. For an improvement in *Hydraulic Docks*; Zebedee King, City of New York, February 13.

Those who are acquainted with the different plans which have been

devised for raising vessels out of the water for the purpose of repair, know that the principle of Bramah's press is applied to that purpose in the Hydraulic Dock, at New York, and probably elsewhere. The present patent is taken for improvements on the mode of constructing and using certain parts of that apparatus, which improvements are explained at large, and fully shown in the drawings, but cannot well be presented in a summary.

[TO BE CONTINUED.]

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*Specification of a patent for an improvement in the art of manufacturing Rope or Cordage. Granted to WILLIAM FANNING, City of New York, February 3rd, 1836.*

To all to whom these presents shall come, be it known, that I, William Fanning, of the City of New York, in the county and State of New York, have invented a new and useful improvement on the art and manufacture of rope, or cordage, made from hemp, flax, cotton, manilla, cicol, or grass, and that the following is a full and exact description of the method of making the circumvolved rope.

What I claim as my own improvement, and not previously known, in the art and manufacture of rope, or cordage, is making the ready, or strand, of the rope, with as many true and separate spiral twists and turns, as there are circles of threads in the ready, or strand, when finished; which is done by first taking as many threads as are necessary to form the inner, or centre, circle of the ready, or strand, placing them through as many holes made circular on a plate; they are then fastened to a machine sufficient to give sufficient turn, and drawn through a tube of proper size, giving to threads and centre circle of ready, or strand, a spiral form in exact proportion to its size. The first circle formed is then put through the centre hole of the plate, and as many threads rove through the holes of the plate in a circular manner, as are necessary to form the second circle; the threads and centre circle first formed, is then fastened to a second machine, standing a proper distance from the first named, and drawn together through a second tube of proper size, the circle of threads last rove completely circumvolving the centre of first circle formed, giving to yarns and second circle a spiral form in exact proportion to size of circle formed, and every succeeding circle is rove through the plate, tubed, twisted, and formed in the same manner as the above described second circle, giving to each circle a spiral form in exact proportion to its size, and every circle of threads rove separately through the holes of the plate tubed and formed, giving a true spiral form to each, will be completely circumvolved by the succeeding circle and rendered impervious to water: the threads are reeled separately on bobbins, and placed in a frame, as usual, in making other ropes. The machine used in making the circumvolved, together with the rope, or band, applied to the same, is such as has been in common use for many years, to which I have no claim of invention or improvement.

WILLIAM FANNING.

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*Specification of a patent for an improved machine for Cutting Straw. Granted to ISAAC S. WRIGHT, Elbridge, Onondaga county, New York, February 3rd, 1836.*

To all whom it may concern, be it known, that I, Isaac S. Wright, of

Elbridge, in the county of Onondaga, and the State of New York, have invented certain improvements in the construction of machines for cutting straw, and I do hereby declare that the following is a full and exact description thereof.

The straw to be cut is placed in a trough in the usual way, but the trough differs in form from those generally employed, being, most commonly, made out of two pieces of plank, joined together lengthwise, at right angles, or at any angle greater or less than a right angle, as may be preferred. This trough has a cutting knife at one end, which is fixed into a frame sliding up and down in grooves, like a mill saw frame. This knife consists of two cutting parts, united together at the middle, so as to form a right angle, or any angle greater or less than a right angle, as may be preferred. The angle of the trough points downwards, and the angle of the knife upwards, the cutting edge being downwards. The gate, or frame, which carries the knife, may be moved up and down by means of a lever, a treadle, a crank, or in any of the known ways of producing such a motion. The fore edge of the trough is armed with iron and steel for the knife to cut against. Both the knife and the trough, may, instead of being in the angular shape described, be made curvilinear, in which case it will be best to make the curve a segment of a small circle in the middle, corresponding with the angular point above mentioned. The object in view will, in either case, be equally well attained; this object being so to form the knife and the trough, that as the former comes down upon the straw they shall concur in gathering and forcing it into a compact state. The same end may be partially attained by giving the described shape to the knife alone. I intend sometimes to surmount that part of the trough which is against the knife, by a short angular or curved piece in the same form with the trough inverted, for the purpose of keeping the upper portion of the straw more completely together whilst feeding. The feeding may be performed in any of the usual ways.

What I claim as my invention, and which I intend to secure by letters patent, is the angular, or curved, form of the knife above described, whether used with or without a trough, similarly formed for the purpose set forth. I do not claim the angular trough when used alone, the same having been previously employed, but without an angular or curved knife, such as is herein described.

ISAAC S. WRIGHT.

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*Specification of a patent for a method of preventing ale, beer, and other malt liquors from becoming acid in warm weather. Granted to JOSIAH STOWELL, Manchester, Hillsborough county, New Hampshire, February 5th, 1836.*

To all to whom these presents shall come, be it known, that I, Josiah Stowell, of Manchester, in the county of Hillsborough, and State of New Hampshire, have discovered and applied to use a new and useful method, or process, for preventing ale, beer, and other malt liquors, from becoming acid, or sour, in warm, or hot, weather, and from preventing the wash, or mash, of distillers, from becoming acid: and that the following is a full and exact description thereof.

To preserve malt liquor where the temperature of the weather is from seventy-four to ninety-four degrees, Fahrenheit's thermometer, for every

one hundred and seventy gallons of liquor apply one pound of raisins in the following manner: Put the raisins into a linen, or cotton, bag, and then put the bag containing the raisins in the liquor before fermentation. The liquor may then be let down at sixty-five, or as high as seventy degrees Fahrenheit's thermometer.

The bag containing the raisins must remain in the vat until the process of fermentation has so far advanced as to produce a white appearance, or scum, all over the surface of the liquor, which will probably take place in about twenty-four hours. The bag containing the raisins must then be taken out, and the liquor left until fermentation ceases. The degree of heat in the place where the working vat is situated, should not exceed sixty-six, nor be less than sixty degrees of Fahrenheit's thermometer.

To prevent distillers' wash, or mash, from becoming acid in hot weather, put about two pounds of raisins into one hundred and fifty gallons of the mash, the raisins to be chopped and put into the liquor without a bag, the wash may be let down into the working vat at seventy-five, or eighty degrees of Fahrenheit's thermometer, if the temperature of the place where the working vat may be, does not exceed seventy degrees. One pound of hops should be put into the wash, or mash, vat, for every eight bushels of malt, at the time of mashing, and three-fourths of a pound of hops for every bushel of malt brewed, to be boiled in the liquor in the copper.

JOSIAH STOWELL.

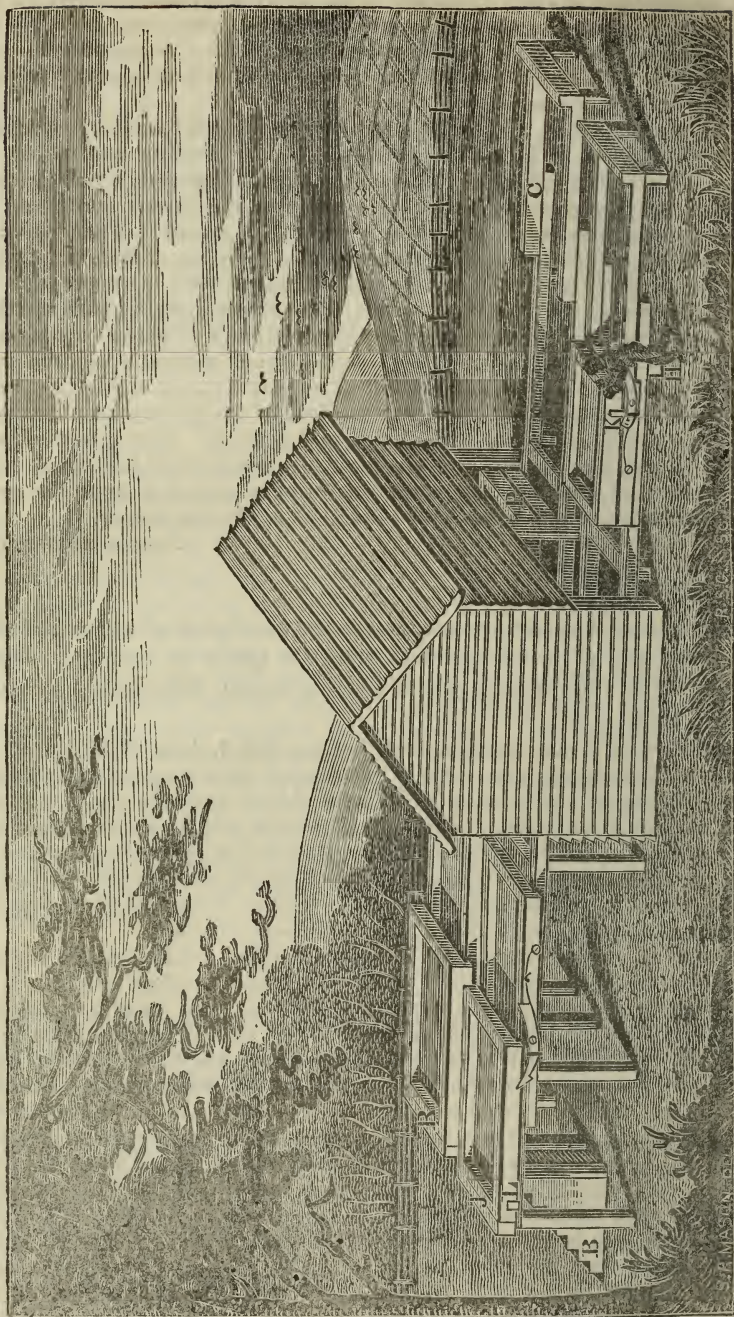
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*Specification of a patent for an apparatus for the drying of cotton and other articles, and of protecting them from the effects of rain and storms.*

*Granted to JOHN PHILBRICK, Wilkinson county, Mississippi, February 12th, 1836.*

To all whom it may concern, be it known, that I, John Philbrick of the county of Wilkinson, in the State of Mississippi, have invented an apparatus for the drying of cotton, after it has been picked from the plant, and of a great variety of vegetable and other substances, which require exposure to the sun and air; and by which apparatus they may be immediately protected from the effects of rain and storms; and I do hereby declare that the following is a full and exact description thereof, reference being had to the drawing which accompanies, and makes a part of, this specification.

I erect a staging, consisting of parallel rails, which are to support platforms, troughs, or cars, upon which the cotton, or other articles, to be dried, are to be spread. These cars, or platforms, may be of any convenient dimensions, but for the sake of description, we will suppose them to be made five feet wide, and eight feet long, and the wheels, or rollers, upon which they run, to be six inches in height. In the accompanying drawing one of these rails is marked with the letter C, and rises six inches, or the height of the platform, above the rail upon which it reclines at its left end. P, B, K, L, are platforms, troughs, or cars, which rest and run upon the rails, having wheels, or rollers, upon their under sides for that purpose. The rails upon which the platforms rest, rise one above the other in the form of steps, as seen in the drawing; the platform marked K, is represented as having passed from the right hand rail on to the next platform, having been pushed forward by the man, H, and now stands upon the platform on the next rail, against which it catches, and both pass together under the shed in



the centre, the pair, marked P, being shown as already there. Those at the left hand of the shed are to be slid in, in the same way, when necessary, and pass above the others. I, is a latch, or catch, by which the two platforms are held together, or released, at pleasure. B, are movable steps, for conveniently reaching, charging, and discharging, the platforms.

Although two only of such platforms are represented as extending on each side of the shed, the number to be used is limited only by the convenience with which they may be managed; and this is the case also with their dimensions. The mode of managing them also, will admit of being varied, whilst the principle upon which they operate will remain unchanged. Thus, for example, the shed may be made to cover the highest platform, and be itself pushed on, so as to gather all the cars, or platforms, under it, in its progress; the platforms may be in a single row, or there may be two or more rows in width, two being shown in the drawing. The platform may be run under the shed by hand, or by means of a winch with a windlass and ropes, or otherwise.

Having thus fully exemplified the general construction and use of my said apparatus, I wish it to be distinctly understood, that I do not intend, by the examples given, to limit myself thereto, but to vary the same in any way I may think proper, whilst the proposed end is attained by analagous means. What I claim as my invention, is the construction of a rail way, in successive steps, and having upon them cars, or platforms, upon which articles to be dried may be exposed to the sun and air, and which may, in a few seconds, be posited upon each other under a shed, to protect them from the weather when necessary, in the manner, or upon the principle, herein set forth.

JOHN PHILBRICK.

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## Progress of Physical Science.

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*Absorption of light by nitrous acid gas.* Sir David Brewster has found that heat so modifies the absorptive power of this gas for the different coloured rays, that while at ordinary temperatures it has an orange colour, by raising the heat it becomes red, and finally black, not a ray of any colour penetrating it. This gas produces in a spectrum formed from artificial light, dark bands analagous to those exhibited by the solar spectrum. By improving the arrangements and methods of observation originally devised by Fraunhofer, of Munich, Brewster has succeeded in detecting two thousand easily recognised portions of the spectrum, separated by thin dark lines, resulting from the absorption of specific rays.

Apparent irregularities in the dark bands of the solar spectrum, were traced to the greater or less proximity of the sun to the horizon, the effect being greatest when the sun sinks below the horizon.

Sir David Brewster infers from a comparison of the lines in the solar spectrum with those produced in the spectrum from artificial light by nitrous acid gas, that the same absorptive elements which exist in the gas also exist in the atmospheres of the sun and of the earth.

Liquid nitrous acid produces none of the fixed lines above alluded to.

Abstract from Lond. and Edin. Philos. Mag. May.

*Fact in the theory of vision.* On the retina and pigment of the eye of the calamary (*Sepia Loligo*). It will be recollected that an important argument in favor of that theory of vision which assigns the choroid coat and

not the retina as the seat of vision is drawn from the supposed structure of the eye of the cuttle fish. Mr. T. W. Jones has recently made a new dissection and microscopic examination of the eye of the *Sepia*, in which he finds that the supposed pigment in front of the retina is not really such, but a nervous expansion of a peculiar texture, tinged of a reddish brown colour, a circumstance which has given rise to the error of supposing it merely a pigment.

Lond. and Edin. Philos. Mag. January.

*Fox's dipping needle deflector.* This is a compendious instrument for determining the magnetic dip, intensity, and variation, invented by R. W. Fox, Esq. of Falmouth, England. It consists of a dipping needle accurately poised on an axis passing through the centre of gravity, to be deflected from the position of the dip by two bar magnets fitting into tubes attached to the back of the instrument, and the tubes being capable of motion round the axis of the needle so as to produce a greater or less proximity of the magnets to the poles of the needle. The needle having first been brought into the plane of the meridian, the approximate dip is obscured while the bar magnets or deflectors are not in place. The plate to which the deflectors are screwed is then moved to make a convenient angle with this dip and the magnets inserted the north pole of one near the north pole, and the south pole of the other near the south pole, of the dipping needle. The needle is thus deflected to a certain angle which is measured. The deflectors are then moved by moving the plate which carries them until they make the same angle with respect to the first dip, but on the opposite of it. The needle is thus again deflected, but in the opposite direction, and the half sum of the observed angles is the dip. By varying the position of the deflectors several observations may be obtained on different parts of the limb of the instrument, and, with a greater or less leverage, in the force of terrestrial magnetism. The relative intensities are observed by the amount of deflection produced by the magnets at a given angular distance from the line of dip, or by weights placed upon a flexible cord passing over a wheel attached to the axis of the needle, either with or without the use of the deflectors. A telescope attached to the plate or arm, carrying the deflectors, serves to determine the variation by a star, or by the image formed by a lens upon a plane of plaster of Paris, when an observation of the sun on the meridian is preferred. The readings of the vertical circle on which the needle plays are made accurate by a second graduated circle, placed near to the front of the box and of course between the eye and the needle. Verniers are provided for reading the angle of the deflectors and the azimuths. The instrument is provided with the usual means of levelling. When packed, the magnets form a circuit, with a view to a permanent condition in the several needles, or bars.

Ann. Rep. Cornwall Polytech. Soc.

*On the electrical relations of certain metals and metalliferous minerals.*—Mr. R. W. Fox finds that the crystalized grey oxide of manganese, holds a much higher place in the electro-negative scale than any other body with which he has compared it, when immersed in various acids, and alkaline solutions. This and some of the other bodies examined by him, rank thus: 1, manganese; 2, rhodium, loadstone, platinum, arsenical pyrites, plumbago, nearly equal; 3, iron pyrites, copper pyrites nearly equal to the second; 4, salina; 5, standard gold; 6, copper-nickel; 7, silver; 8, copper; 9, sheet iron.

Extract from Trans. Royal Soc. Lond. 1835.

*On the properties of liquid carbonic acid.* According to M. Thilorier, this liquified gas presents the strange and paradoxical fact of a liquid more expansible than the gases themselves: from 32° to 86° Fahr., its volume

increases from 20 to 29, that is to say, that at 86° Fahr., the increase of volume is nearly equal to half the volume at 32° Fahr. Its expansion is four times greater than that of atmospheric air, which from 32° to 86° Fahr. only expands  $\frac{30}{267}$ , whilst the expansion of liquid carbonic acid on the same scale is  $\frac{116}{267}$ . If the temperature of a tube containing a portion of liquid carbonic acid is raised, this liquid boils, and the empty space above the liquid is saturated with a greater or less quantity of vapour according to the elevation of the temperature. At 86° Fahr., the quantity of liquid at 32° Fahr. sufficient to saturate the empty space, is represented by a portion of liquid equal to one third of the space in which the vaporization has been effected. At 32° Fahr. the portion of liquid of saturation is only  $\frac{1}{12}$  of the space saturated.

The pressure of the vapour formed by the liquified gas from 32° to 86° Fahr., amounts from 36 to 73 atmospheres, which is equivalent to an increase of one atmosphere for every centigrade degree. It is important to observe that the weight or density of the vapour increases in a much greater proportion than the pressure, and that the law of Mariotte is no longer applicable within the limits of the liquefaction. If the density of the vapour is taken for the base of the pressure, the pressure at 86° Fahr. will be equal to 130 atmospheres, whilst the manoscope will only indicate 73 atmospheres. If a tube of glass containing a portion of liquid and a portion of gas be heated, two contrary effects will take place :

- 1st, the liquid will augment by expansion;
- 2nd, the liquid will diminish by vaporization.

The thermoscopic effects are very different according as the portion of liquid is greater or smaller to the portion of gas; the liquid in the tube will either expand, contract, or remain stationary. These anomalies furnished the means of verifying the numbers which the preceding researches had given on the expansion and vaporization. According to these numbers, the points of equilibrium above which the liquid increases, and below which it diminishes on the addition of heat, result from such a proportion when empty or full, that at zero the liquid occupies  $\frac{13}{30}$  of the whole tube. If the liquid at 32° Fahr. occupies one third of the tube it seems as a retrograde thermometer, of which the liquid increases by cold, and diminishes by heat. If the liquid at 32° Fahr. occupies two thirds of the tube it acts as a regular thermometer ; that is to say, the liquid increases and diminishes according to the laws of expansion. This thermometer is limited at 86° Fahr. as at this temperature the tube is entirely filled by the liquid.

The specific gravity of this liquefied gas at 32° is 0.83, water being 1. It presents the singular phenomenon of a liquid which from — 63° to + 86° Fahr., runs through the scale of densities from 0.90 to 0.60. It is insoluble in water, with which it does not mix; but is soluble in alcohol, æther, naphtha, oil of turpentine, and sulphuret of carbon, in every proportion ; it is decomposed in the cold, with effervescence, by potassium; it does not act sensibly on lead, tin, iron, copper, &c.

When a jet of liquid carbonic acid is directed upon the bulb of an alcohol thermometer, it falls rapidly to — 194° Fahr.; but the frigorific effects do not correspond with this decrease of temperature, which is accounted for by the almost absolute want of conducting power, and the little capacity for heat, of the gases; therefore the intensity of the cold is enormous, but the sphere of action is limited in some measure to the point of contact. If the gases have little effect in the production of cold, such is not the case with the vapours, of which the conducting power and the capacity for heat are

much greater. If æther, for instance, could be placed in the same conditions of expansion as the liquefied gas, a much greater frigorific effect would be obtained than by liquified carbonic acid. To accomplish this object it is necessary to render æther explosive, which is easily effected by mixing æther with liquid carbonic acid. In this intimate combination of two liquids which dissolve one another in every proportion, the æther ceases to be a liquid permanent under the pressure of the atmosphere; it becomes expansive similar to a liquefied gas, at the same time preserving its properties as a vapour; that is to say, its conductivity and capacity for caloric.

The effects produced by a tube filled with explosive æther are remarkable; a few seconds were sufficient to congeal 722 grains of mercury in a glass vessel. On exposing the finger to the jet which escapes, the sensation is intolerable, and seems to extend much further than the point of contact.

M. Thilorier intends to replace æther by sulphuret of carbon; and it is probable that the effects obtained will be still more powerful.

Annales de Chimie, et de Phys. and Lond. and Ed. Phil. Mag.

*Solidification of Carbonic Acid.* M. Thilorier has read to the Academy of Sciences a memoir containing an account of the means by which he rendered carbonic acid solid; and he also gave some details respecting liquid carbonic acid.

He finds the specific gravity of the liquid acid to be .83, water being 1.; it dissolves in all proportions in alcohol and æther: potassium decomposes it, but the common metals do not. A jet of carbonic acid, directed upon a spirit thermometer, caused it to fall  $194^{\circ}$  below zero Fahr. The cold would have been still greater if the bulb of the thermometer could have been entirely covered by the jet.

The solidification of carbonic acid was effected in the following manner: a jet of liquid carbonic acid was received in a glass vial; the expansion of which it undergoes is about 400 times its original volume, and by this so intense a cold is produced, that one part of the carbonic acid congeals in a white powder and adheres to the glass. This powder exists for some minutes, and without any pressure. If the finger be placed in solid carbonic acid, the heat converts it into gas, the expansion of which repels the finger. A few grains of this powder, closed in a vessel, soon expelled the cork.

Solid carbonic acid contains a little water, which is doubtless derived from the moisture of the air. In order, however, to remove all doubts, it would be necessary to get rid of the hygrometric moisture, both of the air and of the vessels, because it might be supposed that this water facilitates the congelation of the acid, as is the case with chlorine.

As to the temperature of this congelation, it was determined by using a spirit thermometer graduated to  $187^{\circ}$  below zero, to which about  $44^{\circ}$  must be added for the tube of the thermometer which could not be cooled, so that the cold observed was not less than  $231^{\circ}$ .\*

These experiments were verified by commissioners, among whom were MM. Thenard and Dulong.

Journal de Chim. Med., tome ii. p. 3, and Lond. and Edin. Philos. Mag.

*Water of the Elton, Dead, and Caspian Seas.*† The Elton sea lies to the east of the Volga, 274 versts ( $181\frac{1}{2}$  miles), south from Saratov. Its greatest diameter, from east to west, is 17 ( $11\frac{1}{4}$  miles), and its smallest diameter 13 versts, ( $8\frac{1}{2}$  miles).

\* These are lower temperatures than have ever before been artificially produced, and lower also, we believe, than any which have yet been observed in nature.—Ed.

† Poggendorff's Annalen xxxv. 169.

The specific gravity of the water, at  $53\frac{1}{2}^{\circ}$ , is 1.27288, according to Rose. Its contents are, according to Rose and Erdmann:—

	ROSE.	ERDMANN.
Chloride of sodium, . . . .	38.3	71.35
Chloride of potassium, . . . .	2.3	
Chloride of magnesium, . . . .	197.5	165.39
Sulphate of magnesia, . . . .	53.2	18.58
Sulphate of lime, . . . .		.36
Sulphate of soda, . . . .		3.84
Carbonate of magnesia, . . . .		.38
Water and organic matter, . . . .	708.7	740.10
	<hr/> 1000.0	<hr/> 1000.00

When the temperature of the sea falls, Epsom salt precipitates. Here it is evident that the specific gravity and composition must change with the temperature. The shore of the Elton sea exhibits, in summer, crystals of gypsum and common salt; and, in winter, besides these, Epsom salt, which, in summer, is again dissolved, so that pure common salt may be obtained here. In the cool summer nights, according to Pallas, Epsom salt is deposited, and is again dissolved during the day. The greater the quantity of chloride of magnesium and Epsom salt, so much the less is there of common salt; which, from the elevation of the temperature, dissolves in no greater quantity in the same. Hence, the reason for the small quantity of common salt which Rose obtained. When an analysis of such a saturated water is given, it is absolutely necessary to give the specific gravity and the temperature. The reasons given are sufficient to account for the difference in the two analysis.

Erdmann found the constituents of the Bogden sea,

Sulphate of lime, . . . .	.74
Sulphate of magnesia, . . . .	10.30
Sulphate of soda, . . . .	215.76
Muriate of lime, . . . .	8.85
Muriate of magnesia, . . . .	48.53
Water, . . . .	715.72
	<hr/> 1000.00

The water of the Elton sea resembles that of the Dead sea, but the latter has a less specific gravity, and a smaller quantity of solid constituents. The quantity of salt diminishes when the Jordan is overflowed. Gay Lussac allowed the water to cool to  $19^{\circ}$  F. without separating any salt; while Klaproth states, that at the bottom of the flask which contained the specimen which he examined, crystals of common salt were deposited, which soon disappeared. The specific gravity of the Dead Sea varies, and the reason is obvious. Macquer, Lavoisier, and Sage found it 1.240; Marcet and Tennant 1.211; Klaproth 1.245; Gay Lussac at  $62^{\circ}.6$ , 1.2283; Hermbstadt at  $60^{\circ}$  1.240. The proportion of ingredients also varies. Gay Lussac found them 26.24 per cent.; consisting of chlorides of sodium, calcium, magnesium, and potassium, and traces of gypsum, differing from that of the Elton Sea by the absence of Epsom salt, and the presence of chloride of calcium.

According to Marcet, the specific gravity of the water of the Sea of Urmia is 1.16507, and its constituents 22.3 per cent, consisting of common salt, Epsom salt, and sulphate of soda. The saline contents of Urmia and

the Dead Sea are, therefore, inferior to those of the Elton Sea. Rose has appropriated all the sulphuric acid to the magnesia, because he has found that when common salt and Epsom salt are dissolved in a sufficient quantity of water and evaporated in a summer heat, the two salts separate; and when much common salt is dissolved along with a small quantity of Epsom salt, a part of the common salt separates first, and then the Epsom salt, while common salt remains in solution; as by the heat of summer, Epsom salt is less soluble than common salt. When the temperature is raised above 122° F. or sunk to zero, in both cases, glauber salt and chloride of magnesium are formed.

Rose found the specific gravity of water brought from the Caspian Sea 75 versts from the islands formed by the Volga, at 54½°, 1.0013; and its contents,

Chloride of sodium,	. . . . .	.754
Sulphate of soda,	. . . . .	.036
Sulphate of lime,	. . . . .	.406
Bicarbonate of lime,	. . . . .	.018
Bicarbonate of magnesia,	. . . . .	.440
Water with a small quantity of organic matter,	. . . . .	99.348

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1000.000

Record Gen. Sc. February.

*Rationale of cold produced by sulphate of Soda and muriatic acid.*  
 Doct. Kane makes the following statement in a paper on the action of muriatic acid on the sulphates. "It has been long known that Glauber's salt treated with muriatic acid constitutes a powerful freezing mixture, the theory of which is at once explained by the results of the experiment. When sulphate of soda is dissolved in liquid muriatic acid there are formed bisulphate of soda and chloride of sodium, and as the former salt crystalizes with only four atoms of water, the remaining quantity of the water of crystallization of the Glauber's salt, is disengaged to the amount of sixteen atoms." "This large quantity of water suddenly separated from a state of combination in which it had been solid, produces, by its absorption of caloric of liquidity, the frigorific property." Lond. and Edin. Philos. Mag. May.

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### Progress of Practical and Theoretical Mechanics and Chemistry.

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#### *Description of a new Detached Pendulum Escapement, invented by Alexander Witherspoon, watch-maker, Tranent.\**

A, is the pendulum rod, represented as having nearly reached the limit of its vibration to the left, and as about to touch the small friction roller attached to the arm C D of the impeller B C D E. The upper part of the pendulum rod is broken off to show the axis B, concentric with the axis of motion of the pendulum itself, on which the impeller turns. The two axes coinciding in direction, no rubbing ought to take place though there were no friction roller at D; the roller is merely placed there for the purpose of preventing the bad effects of any small error in the adjustment. In the drawing, the weight of the impeller is represented as sustained, through the intervention of the slender spring E F, by the lifting pin F, which is placed near the centre of

\* Read before the Society of Arts, 13th April, 1831.

the scapement wheel; this wheel itself being prevented from advancing by the opposition of the detent to the detaining tooth H. The end of the spring E F is furcated, the pin resting in the bottom of the notch, and keeping the spring bent upwards from its natural position by a distance rather more than the minute diameter of the pin.

The oscillation of the pendulum is so nearly completed, that, when finished, the impeller B C D E may be lifted till the extremity of the spring just escapes from the pin F, and takes up a position a little to the left of its present one. The whole weight of the impeller now rests upon the pendulum; but when the pendulum begins to retire, the extremity of the spring is not arrested by the pin F, but passes close by it, directing its motion towards the pin G.

The impeller continues to press against the pendulum rod, and increases its momentum until the arm B E reaches a pin at L, projected from the branch of the detent H K L. After this the pendulum continues its oscillation uninterrupted.

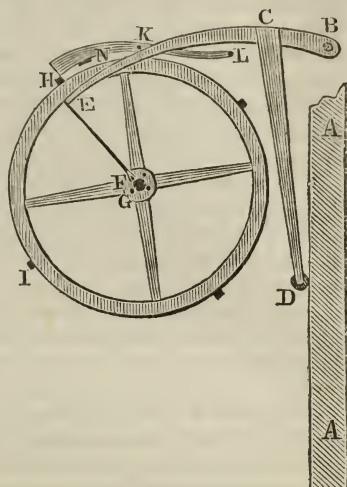
The detent turns upon an axis at K, so that the pressure of the impeller upon the pin L elevates the detent, and allows the detaining tooth H to pass forward.

Just at this moment the second lifting pin G is entangled between the sides of the notch in the extremity of the spring E F; the motion of the wheel, therefore, again elevates the impeller, the rise of which allows the detent to descend upon the stop N and await the arrival of the second detaining tooth I, whose arrest is announced by a distinct beat.

The whole of the escapement has now assumed a position exactly analogous to that which it had at first, and awaits the approach of the pendulum, to solicit anew its maintaining power.

During the whole of this action the pendulum is never connected with the train of wheels. The only body which acts upon it is the impeller, and this communicates to it the impulse which is generated by a descent of a constant weight through a determinate distance. The lightness of the parts renders oil either on the axis B or on the pin F unnecessary, so that this action is entirely freed from any error which might have arisen from changes in the adhesiveness of oil. In order to solicit the impulsion, the pendulum has to raise the impeller through a distance determined by the thickness of the pin F, and has to overcome the friction of the spring against that pin. But the diameter of the pin is so small and the flexure of the spring so slight, that the errors caused by them must be exceedingly small, especially when we consider that they are not liable to any variation. The unlocking of the detent H, instead of being performed by the pendulum, is effected by the impeller; so that, however variable may be the maintaining force, provided it is never so small as to be unable to raise the impeller, nor so great as to prevent the unlocking of the detent, the going of the clock can never be in the slightest degree affected.

When the pendulum rod reaches the friction-roller, it is moving with a



very small velocity, since it is almost at the limit of its oscillation, so that nothing analogous to the blow of the common 'scapements takes place; and even the sudden removal of the pressure of the impeller, when the arm reaches the pin L, can hardly excite any tremour in the pendulum.

In almost all delicate escapements, high finish in the rubbing surfaces and great accuracy in the workmanship, are absolutely essential to good going. In every case the advantage of careful execution cannot fail to be felt; but in this escapement that advantage is by no means great. The execution of the train is almost a matter of indifference; and even in the most vital part, though the distances of the detaining teeth were inaccurately laid off, the errors would occur at every revolution of the escapement wheel, and their effects on the going would be generated and destroyed in the same period, so that the daily or hourly rate could not be affected.

The motion of the train resembles that of a perfect dead-beat, although the escapement certainly partakes of the nature of the recoil, since the unhooking of the spring is only effected after a slight elevation of the impeller. The beat is made only at each second oscillation, so that, in order to beat seconds, a half second pendulum must be used. In escapements which beat at each vibration, it is difficult to have two consecutive intervals exactly equal,—the one being less, and the other as much more than an exact second; but when the beat is given only on one side, no such inequality can exist.

The parts of the impeller are liable to expansion by heat, but the effects of this can easily be obviated by extending an arm made of some expansive metal such as zinc, on the other side of the axis B, while the branches represented in the figure are made of glass. This arm also will allow a weight to be slid along it so as to regulate the intensity of the impulse.

When the spring is released from the pin F, it does not merely assume its position of rest, but continues for a moment to vibrate on each side of it. As there might appear to be some risk of its catching again the same pin, a damper has been put on to diminish these oscillations; but, as in some other escapements which I have constructed on the same principle, it was not found necessary; it has been omitted in the drawing. I need hardly point out that the number of lifting pins is not limited to four. *Jameson's Journal.*

*Capillary Tubes in Metal.* The sum of five pounds was presented to Mr. J. Roberts, 64 Queen Street, Cheapside, for his method of subdividing a pipe into capillary tubes; a specimen of which has been placed in the Society's Repository. The thanks of the Society were voted to Hen. Wilkinson, Esq. Pall Mall, for his method of producing a ring of capillary tubes. For gas-burners, for the safe combustion of mixtures of oxygen and hydrogen, and for other purposes, it is often desirable to divide the end of the discharge-pipe into fine capillary tubes, of the depth of half an inch or more. It is difficult and expensive to bore such apertures in a piece of solid metal, and it is hardly possible to be executed at all if the apertures are required to be of very small diameter.

Mr. Roberts very ingeniously and expeditiously subdivides the end of a metal pipe into small tubes of any required depth, by means of pinion-wire. Pinion-wire is made by taking a cylindrical wire of soft steel, and passing it through a draw-plate of such a figure as to form on its surface deep grooves in the direction of radii to the axis of the wire: the ribs which separate these grooves from one another may be considered as leaves or teeth, and of such wire, when cut into proper lengths, are made the pinions used by watch-makers. Hence arises the name by which this wire is commonly known.

If now a piece of this wire be driven into the end of a brass pipe of such a size as to make a close fit with it, it is evident that that part of the pipe has thus been subdivided into as many smaller tubes as there are grooves in the wire. By using a draw-plate fitted to make smaller and shallower and more numerous grooves than are required in common pinion-wire, it is manifest that wires or cores may be produced, which, when driven into metal pipes, as already described, will subdivide them into capillary tubes of almost any degree of tenuity.

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Mr. H. Wilkinson's method is described in the following letter:

*Pall Mall, May 25th, 1835.*

SIR, In the course of some experiments on artificial light, which I was engaged in about twelve months since, I was desirous of obtaining a great number of extremely minute apertures for a gas-burner; and, finding it impossible, in the ordinary way, to obtain them, a new method occurred to me, which immediately produced the desired effect. I showed it at the time to several eminent scientific men, who were unable to conceive how these apertures were formed; and, as I made no secret of the method, they were equally pleased at the simplicity of the operation; and the specimen herewith sent has been exhibiting at the Gallery of Practical Science for several months. I did not attach much importance to it myself; but, as I do not find that it is at all known, and now think it might be useful in a variety of ways, I have sent it to you to be laid before the Society; and should they be of the same opinion, I shall feel much pleasure in communicating the mode of operation, by which any number of apertures, hardly visible to the naked eye, and of any length (*even a foot, if required*), may be made in any metal in *ten minutes!*

I am, sir, &c. &c.

HENRY WILKINSON.

A. AIKIN, Esq. *Secretary, &c.*

The process consists merely in turning one cylinder to fit another very accurately, and then, by milling the outside of the inner cylinder with a straight milling tool of the required degree of fineness, and afterwards sliding the milled cylinder within the other, apertures are produced perfectly distinct, and of course of the same length as the milled cylinder. A similar effect may be produced on flat surfaces, if required.

H. W.

*Trans. Lond. Soc. Arts.*

*Duty of Cornish Steam Engines.* The mode of estimating the performances of steam-engines, *by the number of lbs. lifted one foot high by the consumption of a bushel of coal*, was introduced into Cornwall by Watt, when it became requisite to keep a regular account of the work done and the coal consumed, for the purpose of calculating his share, which was one-third of the saving of coal effected by his engine in comparison with Newcomen's.

The performance of two atmospheric engines, at Poldice, had been ascertained as a standard of comparison, and declared by a committee: for convenience the present dynamic unit was afterwards adopted, and the work done when thus expressed was equal to 7,037,800 lbs. lifted one foot high by each bushel of coal. A dispute arose in 1798 between Messrs. Boulton and Watt and the mining adventurers in Cornwall, and it became necessary to ascertain the average duty, which was proved to be 17,671,000 lbs.: this was rather less than in 1793, when the average of seventeen engines was 19,569,000 lbs. After the expiration of the patent in 1800, no

accounts were kept of the work performed by the engines under the direction of the mining engineers.

In August, 1812, the average duty of several engines on a month's trial proved to be only  $13\frac{1}{2}$  millions, and the truth of the prevailing opinion became apparent, that less work was done than during Watt's patent. The present monthly report of 'work performed' was then established under the management of Mr. Lean, and since his decease has been conducted by his son, so that there exists a series of reports for twenty-two years, showing the duty for each month, of the engines employed in Cornwall, including the size of the pumps, and their depths, number of strokes, bushels of coal consumed, &c. &c.; a reference to which would point out at what period, and by whom, every increase of duty was obtained.

Woolf introduced the use of high pressure steam worked expansively in two cylinders, and first succeeded in performing fifty millions. Other engineers worked high steam expansively in one cylinder, which plan became general on the introduction of Trevithick's cylindrical boilers.

Several engines now constantly perform a duty exceeding 70 millions, double that of the best of Watt's, and of which one has reached 91,200,000; another mentioned last meeting by our President, averages about 90,000,000; its best performance was 97,800,000, for one month.

Part of the increase of duty must be attributed to the improved pitwork; the most rapid increase, however, took place on the introduction of a most complete system of *clothing*, the present practice of which is so efficient, that in two instances, though the steam in the *jacket* was at least  $270^{\circ}$ , the outside casing did not exceed  $78^{\circ}$ ;—the thermometer was covered by a silk handkerchief to prevent the draught of air in the engine-house affecting the results;—the air outside was in one experiment  $56^{\circ}$ , and in the engine-house about  $66^{\circ}$ ;—the surface of the ashes over the boilers was about  $90^{\circ}$ ."

Ann. Report Cornwall Polytech. Soc.—Lond. Mech. Mag. April.

## Progress of Civil Engineering.

*Observations on the Classification [and Details of the Architecture of the Middle Ages.* By E. B. LAMB, Esq. Architect.

(CONTINUED FROM p. 141.)

*The Third Class* commenced about 1377, and continued till 1460. In the first division of this class the equilateral arch was given up for one struck with two centres, of an obtuse form, which was much used with the four-centred arch (*Fig. 11*). The window heads were filled with tracery in the perpendicular lines (*Fig. 12*) the predominating charac-

*Fig. 11.*



*Fig. 12*



ter of the whole of this class, and the mouldings, became gradually more complex. The windows, for some time, retained the simple arch, the

compound arch only being used in small openings. Windows were divided in their height by transoms, and sometimes columns were added to mullions. *Fig. 13*, is a selection of a small window jamb, at Ifly Church, which shows the general character of the mouldings of the second division of this class. *Figs. 13, 14, 15, 16, 17*, all resemble each other, and mark the distinctness of the mouldings from those of the second class. In these sections it will be observed, that, although the mullions do not, in a very great degree, appear to differ from the mullion mouldings of the second class, yet the extended hollow moulding in

*Fig. 14.*

*Fig. 13.*



the jamb is perfectly in character with the depressed simple, and also with the compound, arch. It is very different from the easy flowing lines of the second class; and the mullions, though they appear, as I before mentioned, to resemble those of the other class, upon closer examination will be found generally to be of a more bulky character. The elegant flowing lines of the second class are, indeed, in no instance to be seen in this, and the expression is of a widely different nature; for,

*Fig. 15.*



*Fig. 16.*



while the former indicated a graceful undulating character, without interruption, the latter is expressive of a degree of abruptness and crispness peculiarly its own: at least, these are impressions made upon me by these two classes; and they appear to arise from the obvious difference in the expression. A profusion of heraldic devices were among the principal decorations of this period. Among the examples of this class are, of the first division, New College Chapel, Oxford; a window in Westminster Hall; and the west door of St. Saviour's Church, which is a fine specimen of the middle division; a window in St. Peter's Church, Oxford, of which *Fig. 14*, is the section of the jamb; also Merton College Chapel, Oxford, 1424; and King's College Chapel, Cambridge, 1443. Of the latter, or transition, division of this class, may be mentioned the Chapel on the Bridge, Wakefield, Yorkshire.

*The Fourth Class*, is a continuation of the same general forms, from 1460 to about 1547. The mouldings, arches, ornaments, &c., were now wrought to a greater degree of richness; and the most delicate work was bestowed on canopies, niches, groinings, and, in fact, on every part, the principal aim appearing to be to produce stone carving of a net-like character, rather than to preserve good composition by agreeable contrasts. The result of this lavish display of ornament ended in a generally depraved taste, and the consequent decline of the art. Examples of this class will be found in Magdalen College, Oxford, about 1473; centre tower of Canterbury Cathedral, about the same date; St. George's Chapel Windsor, 1481; and Henry VII's Chapel, Westminster, about 1503. In Henry VII's Chapel, and, in fact, in many of the buildings of the fourth class, we can trace a general decline in art, without alluding to the wearisome richness, which becomes fatiguing to the eye for want of repose. I have no doubt I lay myself open to much reproof for presuming to differ from the accepted opinion with regard to this class of architecture; but I think I need only refer to the exterior of Henry VII's. Chapel in vindication of my assertion. This exterior is cut into so many small parts, that there is scarcely any situation from which a pleasing view of it can be obtained; and the principal charm which it possesses in point of effect is borrowed from its contrast with the Abbey: the whole exterior, in short, is a multiplicity of angular projections, which throw no shadow, and, consequently, produce no relief. The interior is much better:

*Fig. 17.*



the effect here is good; the light and shade, being distributed from the large clerestory windows, are more pleasing; and the fan-groining and pendants of the nave and aisles produce a rich effect: but, still, I cannot see the beauty of these angles and curves, even in the interior; though they are certainly better here than on the outside.

In the latter division of this class, the mouldings and mullions were changing their pure form, and becoming mixed with the Italian architecture, which was, about this time, making great progress in the formation of that mongrel style now called Elizabethan; and many examples of this transition work are to be seen in Oxford, Cambridge, and London. Eastbury House, Barking,

in Essex, is a fine specimen of the brick buildings of the early part of the reign of Henry VIII., and contains more pure mouldings than most of the other buildings of that time: it is built entirely of brick work; mullions, transoms, and the most delicate ornaments, being all executed in brick. *Fig. 18*, is a section of one of the window jambs and mullions. *Fig. 19*, is a section of a mullion and jamb of the transition character. In this figure it will be seen that the jamb mouldings are a hollow and ovolo, and that the mullion is a fillet on one side: the other side, in the same section, is to be seen in the second class occasionally.

*Fig. 18.**Fig. 19.*

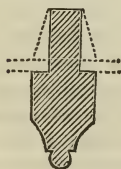
The Elizabethan architecture now became the prevailing style, and continued to hold its rank until Inigo Jones succeeded in changing the public taste in favor of what was then called the perfect Italian style.

The characteristics of the Elizabethan style, are the regular entablatures, columns, pedestals, and arches of Italian architecture, interwoven with the pointed arches, enriched spandrils, heraldic devices, and other decorations of the Gothic. Orders were used over orders, and in situations where they were placed in direct violation to all reason. In one of the Colleges at Oxford, the whole of the five orders are piled one above another in one narrow front. These entablatures and columns were adorned with the most clumsy devices; such as scrolls abruptly terminating in angles, carvings of vegetables in bunches, &c., and buildings being surmounted with obelisks, balls, scrolls, and numerous fantastic devices, without the least reason being shown for their use. In some instances, this style has a very picturesque effect; and, when a sufficient excuse can be shown for its introduction in public buildings, that is the time, and the only time, where it should be introduced; but national buildings should be in a more perfect style. The bad taste shown by the building committee for the Houses of Parliament, in recommending this style of architecture for their Senate House, must be obvious to every person who is the least acquainted with its details: there is ample scope for talent in the pure Gothic style; therefore, why revive a style which only marked the decline of the art?

It only remains for me now to say a few words relative to the Gothic mullion. Windows are divided into lights by mullions of various sizes and sections; and each window consists of an outer arch, or frame, the jamb or architrave mouldings of which are perfectly distinct from the mullion, or column. Mullions are divided into orders; and the small mullion, which generally consists of a hollow and a fillet, or of a splay and fillet, is the first order: it is from this order that the cusps spring in every class; and for that reason it is sometimes called the cusp mullion. Windows of two, three, and some-

times more, lights, have only one order of mullions, particularly windows of the second class; and this single order is continued through the whole of the ramifications of the window head. An increase of strength and richness was produced by the introduction of the second order of mullions; and this was obtained by increasing the thickness of the first order, and adding another moulding to the fillet; which, from the increased thickness, required something to fill up the fillet, and, at the same time, to add to its strength. *Fig. 2*, will show the two orders of mullions of the first class. These had different offices assigned to them: thus, the first order, being the smallest, formed the smallest composition; the second order, from its increased size, formed the larger divisions of the window; and so they might proceed to a third, fourth, fifth, &c., each successively growing out of the other: and the window, *Fig. 3*, will show their application. I need scarcely say, that the largest order of mullions contains all the others, so that the smallest goes round the whole of the window head. *Figs. 5, 7*, show only one order of mullions; *Fig. 2*, shows two orders of the first class; *Fig. 9*, shows three orders of the second class, the first of which is the tracery or cusp mullion; *Fig. 10*, shows one order. It will be observed that the tracery mullion is the same in every window in these figures; and that, though there are instances of two orders being used in tracery, even then the cusp proceeds always from the first order. The cusp rises out of the hollow of the first order, and, in the first class, frequently terminates with a flower, and sometimes square, in the second class it is formed, generally, by the intersections of two segments of circles, but is sometimes square, or a kind of blunted point; and, in the third and fourth classes, it terminates in an angle, and sometimes a flower is attached to it. These rules are not without exceptions; for the artists who could produce such wonderful combinations as are to be found in the architecture of the middle ages, so full of variety and originality in every class, would not be restrained, in the flights of genius, to the same forms or ornaments throughout the same building; and, in every building we examine, we find something to add to our stock of knowledge which we never dreamed of before.

In tracing the change of mullions through the different classes of Gothic architecture, it is curious to observe, that the mullions of the fourth class have been continued down to the present day in our sash bar. In Queen Elizabeth's time, windows were divided into a greater number of lights with transoms; in king James the First's time, they became still more numerous in their divisions, but the mullion was not so bulky; and by degrees the windows had as many transoms as mullions, while every fresh complication of mullions and transoms produced a decline in the thickness; and even the general introduction of the Italian style only tended to decrease the thickness of the mullion, but not to alter its general form.

*Fig. 20.**Fig. 21.**Fig. 22.*

I am not aware of the exact time when the lines and weights for windows

were first introduced; but when they were known they soon became very general, and, I have no doubt, assisted in the reduction of the mullion, which continued to dwindle to what are now called the ovolo, and the astragal and hollow sash bars. *Figs. 20 and 21*, will show these sections. *Fig. 22*, is the section of the mullion of Queen Elizabeth's reign. The great demand for novelty in the present day, and the use of large squares of glass, have been the means of producing new forms, which are so very thin as to be scarcely visible: these are designated by the titles of lamb's tongue, and the bevel bar.

In the foregoing remarks I have endeavored to give a classification of the architecture of the middle ages, very imperfectly, I am aware; but if these observations should induce some one to institute a fuller enquiry into the architecture of this country, and if my remarks should be of the least service to the general reader, in assisting him to find the cause which produced the great effects in the edifices of our forefathers, it will be a gratification to think that I have not studied in vain.

*Henrietta Street, Brunswick Square, August, 1835.*

*On the Expansibility of different kinds of Stone.* By Mr. Alexander J. Adie, Civil Engineer.—“This paper contains the results of an extensive series of experiments made upon different kinds of stone, as well as upon iron and upon brick, porcelain, and other artificial substances. The instrument employed was a pyrometer, of a simple construction, capable of determining quantities not greater than  $\frac{1}{30000}$  of an inch. The length of the substances generally employed was 23 inches. The general result of these experiments is, that the ordinary building materials of stone expand but very little differently from cast iron, and that, consequently, the mixture of those materials in edifices is not injurious to their durability. The experiments from which the expansibility of the substances was numerically determined were made between the limits of the ordinary atmospheric temperature and that of 212°; steam being introduced for that purpose between the double casing of the instrument. The following results were obtained for the fractional expansion of the length, for a change of temperature of 180° Fahr.:—

*Table of the expansion of Stone, &c.*

	Dec. of length of 180° Fahr.		Dec. of length of 180° Fahr.
1. Roman cement,	- .0014349	8. Peterhead red granite,	- .0008968
2. Sicilian white marble	- .00110411	9. Arbroath pavement,	- .0008985
3. Carrara marble,	- .0006539	10. Caithness pavement,	- .0008947
4. Sandstone from the Liver Rock of Craig- leith Quarry,	- .0011743	11. Greenstone from Ratho	- .0008089
5. Cast-Iron from a rod cut from a bar cast 2 in. square,	- .00114676	12. Aberdeen grey granite,	- .00078943
6. Cast-Iron from a rod cast half an in. square	- .001102166	13. Best stock brick,	- .0005502
7. Slate from Penrhyn Quarry, Wales,	- .0010376	14. Fire brick,	- .0004928
		15. Stalk of a Dutch to- bacco-pipe,	- .0004573
		16. Round rod of Wedge- wood ware (11 in. long)	- .00045294
		17. Black marble from Galway, Ireland,	- .00044519

## Mechanics' Register.

*Soap from Flints.* Mr. Sheridan takes the common black flint, calcined, and reduces it to powder by wet-grinding; then mixes it with the caustic soda leys, or potash leys, and boils it till it attains saponification. The mixture so obtained\* is added to the present soap materials after the latter have been boiled to that state when they have become soap, and are ready to be poured into the frames. The mixture, which has a high detergent quality, requires to be well crutched along with the soap materials; and when thus crutched together, the result is a soap of excellent quality. The mixture becomes intimately incorporated with the soap materials, and may be added in proportion of from 40 to 50 parts of the mixture to 50 of the soap materials. Thus the common silex, which is obtainable at a very low price, takes the place of tallow to the extent of nearly one-half. Lond. Mech. Mag.

*Comparative table of Speed.* From the Physical and Chemical Journal of Science, and the Arts of Husbandry in France, we make the following extract, which will be found no less curious than useful, and cannot fail to interest our readers:

	Feet per second.
The ordinary rate of a man walking, - - - - -	4
Of a good horse in harness, - - - - -	12
(Or 2,000 toises (yards) in 8 minutes).	
Of a reindeer in a sledge, on the ice, - - - - -	26
Of an English race-horse, - - - - -	43
Of a hare, - - - - -	88
Of a man casting a stone with all his force, - - - - -	60†
Of a good sailing ship, - - - - -	19
Of the wind, - - - - -	82
Of sound, - - - - -	1,038
Of a cannon-shot (24-pounder) - - - - -	1,300
Of the air which returns into space so divided, - - - - -	1,300

Lond. Farmers' Mag.

### List of American Patents which issued in June, 1836.

	June.
380. <i>Oven.</i> —Wm. H. Atkins, Berkshire, N. Y.	2
381. <i>Cooking stove.</i> —E. G. Currier, Warner, N. Y.	2
382. <i>Cooking stove.</i> —E. G. Currier, Warner, N. Y.	2
383. <i>Plough.</i> —Jacob Plank, Carlisle, Penn.	2
384. <i>Generating light and heat.</i> —Horace L. Barnum, N. Y.	2
385. <i>Granite dressing machine.</i> —J. D. Buzzell, Cape Elizabeth, Maine,	2
386. <i>Cylindrical breaker.</i> —Smith Cram, N. Y.	2
387. <i>Chopping meat.</i> —J. Masser and S. Smith, Mayerstown, Penn.	2
388. <i>Smut machine.</i> —Robt. Engle, Burlington city, N. J.	2
389. <i>Stove for anthracite.</i> —Adrian Jones, Hartford, Conn.	2
390. <i>Blast furnace.</i> —Benjamin Kugler, Philadelphia,	2

\* The compound here alluded to is a combination of silica (silex) and potassa (potash), and is frequently called liquor of flints. Silica is a body still generally ranked with the *earths*, which it resembles in many points, but it is, in its chemical relations, an *acid*, combining with alkalis, and forming salts, which are called silicates. It may be considered a curious fact, if the above statement be correct, that this weak mineral acid should be able to take the place of the weak animal, or vegetable, acids united with alkalis in ordinary soaps.

† We believe this calculation to be incorrect. A stone cast with the strength of a man's arm will outstrip a hare.

391. <i>Thrashing machine.</i> —Jacob S. Rollins, New Gloucester, Maine,	2
392. <i>Mowing machine.</i> —Henry Allen, Fayetteville, Tenn.	2
393. <i>Water wheel.</i> —Henry Allen, Fayetteville, Tenn.	2
394. <i>Pump, frictionless.</i> —Edward Whitfield, N. Y.	2
395. <i>Hemp &amp;c. spinning.</i> —Moses Day, Roxbury, Mass.	2
396. <i>Clover cleaning.</i> —John Goodyear, South Middleton, Penn.	2
397. <i>Propelling boats, &amp;c.</i> —Gideon Hotchkins, Broom county, N. Y.	2
398. <i>Cooking stove.</i> —Charles Higgins, Turner, Maine,	2
399. <i>Saw mill.</i> —Thomas B. Naylor, Jonesville, N. C.	2
400. <i>Tunnelling rivers.</i> —J. B. Bucklin and J. Jacobs, West Troy, N. Y.	11
401. <i>Metallic coffins.</i> —Jonas A. Grant, Richmond, Va.	11
402. <i>Cars, taking over elevations.</i> —Smith Cram, N. Y.	11
403. <i>Weaving, improvement in.</i> —Cullen Whipple, Douglass, Mass.	11
404. <i>Washing machine.</i> —Amory Davidson, Littleton, Mass.	11
405. <i>Boots, tucking machine.</i> —S. C. Blodgett, Rowley, Mass.	11
406. <i>Hubs for wheels.</i> —Jonathan Atherton, Philadelphia,	11
407. <i>Setting bones, apparatus.</i> —James H. Willard, Brownhelm, Ohio,	11
408. <i>Columns for building.</i> —Jordan L. Mott, N. Y.	11
409. <i>Iron and steel, making.</i> —William P. Boyden, N. Y.	11
410. <i>Distances, measuring.</i> —Rufus Porter, Bellerica, Mass.	11
411. <i>Horse power.</i> —Rufus Porter, Bellerica, Mass.	11
412. <i>Churn dash.</i> —Samuel Jackson, Jay, Maine,	11
413. <i>Screw, packing machine.</i> —Stephen Terry, De Kalb, Georgia,	11
414. <i>Endless chain propeller.</i> —Lewis Chevier, Philadelphia,	11
415. <i>Hat bodies, stiffening.</i> —J. P. Kettell and J. Wright, Worcester county, Mass.	11
416. <i>Garden Hoe.</i> —Isaac W. Averille, Plymouth, Mich.	11
417. <i>Bedsteads.</i> —Christian Knisly, Meadville, Penn.	16
418. <i>Malleable iron cannon.</i> —Geo. W. Chapman, N. Y.	16
419. <i>Oven, heating by anthracite.</i> —F. C. Tredwell, Brooklin, N. Y.	16
420. <i>Stove, conical.</i> —Robert Robertson, Albany, N. Y.	16
421. <i>Washing machine.</i> —Amos Sarcum, Troy, N. Y.	16
422. <i>Clover seed hulling.</i> —Cyrus B. Baldwin, Fincastle, Va.	16
423. <i>Scythe.</i> —Ezra Barnett, Warner, N. H.	16
424. <i>Cotton planting machine.</i> —Henry Allen, Fayetteville, Tenn.	16
425. <i>Churn.</i> —Amasa Wharff, New Gloucester, Maine,	16
426. <i>Plough.</i> —Joshua Gibbs, Canton, Ohio,	16
427. <i>Mortising machine.</i> —J. C. Channell, Dunstable, N. H.	16
428. <i>Planing machine.</i> —Lorrain Curtis, Sherburne, N. Y.	16
429. <i>Smut mill.</i> —John T. Towne, Mount Morris, N. Y.	16
430. <i>Stove, or air warmer.</i> —John J. Heintzelman, Philadelphia,	16
431. <i>Leather, shaving.</i> —Herkimer Johnston, Brooklin, Conn.	16
432. <i>Cooking stove.</i> —Will. A. Arnold, Northampton, Mass.	16
433. <i>Rice, &amp;c. hulling.</i> —Lewis Cole, New Gloucester, Maine,	16
434. <i>Fire proof chest.</i> —James Matthews, N. Y.	16
435. <i>Mortising timber.</i> —Samuel E. Babcock, Alstead, N. H.	16
436. <i>Combing wool.</i> —S. and S. Couillard's assignees, Boston, Mass.	16
437. <i>Combs of metal.</i> —Henry Duvall, N. Y.	20
438. <i>Lamp burner, light house.</i> —Isaac Dunham, Bristol, Maine,	20
439. <i>White lead, &amp;c.</i> —Edward Clark, Saugerties, N. Y.	20
440. <i>Cutting and planing stone.</i> —A. Clark & C. H. Boynton, West Stockbridge, Mass.	20
441. <i>Winding silk.</i> —Adam Brooks, South Scituate, Mass.	20
442. <i>Winding gimp or cord.</i> —Adam Brooks, South Scituate, Mass.	20
443. <i>Thrashing machine.</i> —J. Bailey and J. Sprinkle, Rockingham, Va.	20
444. <i>Horse power.</i> —William Whitman, Haverhill, N. H.	20
445. <i>Truss.</i> —John W. Newson, N. Y.	20
446. <i>Window fastenings.</i> —Marcus Merriman, jr., New Haven, Conn.	20
447. <i>Mortising machine.</i> —John Hawkins, Stockbridge, Mass.	20
448. <i>Stone cutting machine.</i> —J. and J. Sutton, Reading, N. Y.	20
449. <i>Rack wrench.</i> —Alonzo G. Hall, Troy, N. Y.	20
450. <i>Saddle, elastic.</i> —William McCormick, Bath county, Kentucky,	20
451. <i>Revolving lancet.</i> —T. C. Harrison, New Egypt, N. J.	20
452. <i>Clover seed, cleaning.</i> —Hildreth Robbins, Kennebec, Maine,	20

(TO BE CONTINUED.)

## CELESTIAL PHENOMENA, FOR OCTOBER, 1836.

Calculated by S. C. Walker.

Day.	H <sup>r</sup> .	Min.					
17	6	57	Im	Capricorni	,6,	N.132°	V.136°
17	8	10	Em			271	290
30	15	40	Im	ω' Cancrī	,6,	24	5
30	16	57	Em			315	311

## Meteorological Observations for June, 1836.

Moon. Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
	Sum <sup>2</sup> rise.	2 P.M.	Sum rise.	2 P.M.	Direction.	Force.		
1	44°	54°	Inches 29.80	inches 29.84	E.	Brisk.	.60	Cloudy—showers, rain in night
2	54	61	29.76	29.76	E.	do.	.16	Drizzle—cloudy—rain.
3	55	60	29.76	29.80	E.	Moderate.	1.00	Drizzle—cloudy—rain in night.
4	56	64	29.80	29.80	E.	do.		Rain—Cloudy.
5	58	67	29.85	29.90	E.N.E.	do.	.45	Drizzle—cloudy.
6	57	67	29.90	29.90	E.N.E.	do.	.07	Cloudy—rain.
7	60	74	29.94	29.94	E.	do.		Fog—flying clouds, rain.
8	64	74	29.90	29.96	E. S.E.	do.		Fog—flying clouds.
9	64	86	29.97	29.97	S.W.	do.		Fog—clear.
10	62	78	29.98	30.05	N.N.E.	do.	.22	Clear day.
11	60	83	29.95	29.80	E.S.	do.		Clear day.
12	64	79	29.83	29.80	W.	do.		Fog—flying clouds, rain.
13	58	74	30.00	30.05	E.S.E.	do.		Clear—flying clouds.
14	58	75	30.00	29.95	N.E.N.	do.		Floating clouds—clear.
15	59	76	29.93	29.93	N.W.	do.		Cloudy—clear.
16	54	80	30.05	30.05	N.W. W.	do.		Clear day.
17	66	86	29.90	29.90	W.	Brisk.	.25	Floating clouds, clear.
18	68	89	29.85	29.85	W.	do.	.70	Clear day.
19	68	86	29.80	29.75	N. E.	Gale.	.25	Hazy—clear, thunder shower.
20	70	64	29.70	29.70	N.	do.	1.30	Clear day—thunder shower.
21	54	60	29.70	29.70	E.S.E.	Moderate.		Cloudy—rain, thunder & lightning
22	55	66	29.83	29.85	S. E.	do.		Drizzle—cloudy.
23	56	61	29.90	29.90	E.	do.		Cloudy—cloudy.
24	59	59	29.90	29.84	E.	do.		Cloudy—rain.
25	54	62	29.84	29.84	E.	do.		Cloudy—cloudy.
26	54	58	29.84	29.85	E.	do.	1.40	Drizzle—cloudy.
27	54	64	29.90	29.85	E.	do.	.41	Rain—rain in night.
28	56	78	29.85	29.85	N.W. W.	do.		Cloudy.
29	62	80	29.80	29.80	E.	do.		Clear—lightly cloudy.
30	61	80	29.85	29.85	W.	do.		Lightly cloudy—clear.
Mean	58.63	71.50	29.87	29.87			6.56	Clear day.

Thermometer.

Barometer.

Maximum height during the month. 89. on 18th.

30.05 on 10th, 13th, 16th.

Minimum do. 44. on 1st.

29.70 on 20th, &amp; 21st.

Mean do. 65.07

29.87

**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**  
DEVOTED TO  
**Mechanical and Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

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OCTOBER, 1836.

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**Practical and Theoretical Mechanics.**

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*Report of the Committee of the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, on the Explosions of Steam Boilers. PART II.,\* containing the GENERAL REPORT of the Committee.†*

The Committee appointed "to examine into the causes of the explosions of the boilers used on board of steamboats, and to devise the most effectual means of preventing the accidents, or of diminishing the extent of their injurious effects," respectfully submit to the Board of Managers of the Franklin Institute, the following report:

The Committee undertook the task imposed upon them by the Franklin Institute, with a deep sense of the responsibility which it involved. On the one hand, a series of disasters by which human life was sacrificed, called loudly for an investigation of the causes which produced them; on the other, an untimely or ill-directed interference with a branch of industry, which has been a source of unparalleled advantage to our country, was truly to be deprecated.

Emanating from an Institute "for the promotion of the Mechanic

\* For Part I. See Vol. XVII.

† The copy right for this report is secured according to law, by the Franklin Institute.

Arts," the Committee felt advantageously situated. They could not justly be suspected of a desire to trammel the progress of any art; and yet the public confidence, which had always been accorded to the institution, would naturally attach to a Committee selected by it.

The Committee further believed that the apprehensions of the public, aroused by the frequent recurrence of accident, could only be satisfactorily allayed by an investigation, which would show that such accidents were not unavoidably incident to the useful agent which they distrusted, but resulted from a want of due regulation of its power, or from circumstances incidental to its use which could be foreseen, and therefore guarded against. If disappointed in this anticipated result of investigation, the Committee hoped to satisfy those who are public carriers, that it was their duty to provide protection for those who trust life in their hands, against an agent thus found to be uncontrollable.

With these views the Committee commenced, actively, the collection of information upon the subject intrusted to them. The replies to their circular were canvassed in their meetings, and finally laid before the public.\* It occurred most opportunely for the ultimate success, though not for the rapid completion of their labours, that an opportunity was afforded them for experiment, by which to test many of the suggested causes of, and preventives to, the explosions of steam boilers.

These experiments, originally proposed by our public spirited fellow-citizen, S. D. Ingham, Esq., then Secretary of the Treasury of the United States, have been brought to completion and presented to the public under the auspices of the present Secretary.†

The Committee trust that they have, by the experiments just referred to, shown not only what are some of the causes of explosion, but, which is quite as important, what are certainly not causes. In this way they hope to have turned away the attention of ingenious men from false hypotheses which cannot furnish the remedies they are in quest of, and to have pointed out some directions in which their labours may be profitably bestowed.

A desire to complete the reports upon their experiments, has induced a delay in the present report, which, thus far, however, the Committee are satisfied will be found to have been judicious. This conclusion they rest upon the many references, which will appear in the following pages, to those experiments, which have given an authority to recommendations and suggestions, that could not have been claimed for them unless thus strongly supported by facts.

They regret much that the part of their report referring to the strength of materials will, from circumstances, be unavoidably incomplete. This deficiency, they hope, will hereafter be made up, the experiments on the subject having been some time since concluded; and they do not feel warranted, by this cause, in any longer delaying their general report.

\* As these replies will be frequently referred to in what follows, it is proper to state here, that the references are made to the pamphlet distributed by the Committee to their correspondents and others, and that Nos. I. to XIII., both inclusive, were published in the "Journal of the Franklin Institute of Pennsylvania for the promotion of Mechanic Arts," Vol. VIII.; Nos. XIV. to XXVIII., both inclusive, in the same Journal, Vol. IX.; No. XXVIII., part second, and XXIX., in Vol. X.; and No. XXX. in Vol. XI.

† Hon. Levi Woodbury, for whose promptness in forwarding their views, the Committee beg leave here to return thanks.

In this report the Committee have endeavoured, by examining the different accounts of explosions on record, and the writings on collateral subjects, to ascertain what causes have been operative in producing these disasters. The difficulty of procuring satisfactory testimony in regard to them, has been often pointed out. Most frequently those from whose mismanagement or want of vigilance they have immediately resulted, have been victims to them, and when they have survived, the precise state of things before the occurrence was imperfectly known to them; and, however honest, their minds have received a bias towards the non-existence of certain circumstances judged likely to have produced the results.

It hence follows that in regard to many explosions, either none of the circumstances which immediately preceded them, and bearing upon them, are known, or by inaccurate statements of them, an appearance of mystery is thrown around the whole matter, calculated to baffle research, and to alarm the community, who are exposed to a recurrence of the same dangers. Thus it happens that of the numerous explosions on record, few are made to subserve the cause of humanity, by a knowledge of their proximate causes. The details of the number of killed and wounded, and of the more or less entire destruction of the boilers and of the boats, are given in the daily prints, and public curiosity is satisfied.

In making their examination, then, of the cases of explosion, the Committee have selected such as they have found most directly to the points in support of which they are cited; omitting others in which the facts are less clearly made out, or in which the causes assigned may be resolved into matters of opinion. Having themselves no theory, or theories, to support, they have of course not been biassed, by such views, in the selections made.

This mode of proceeding is, obviously, not calculated, by one effort, to exhaust a subject. But the Committee believe, that they are able to make a decided step forward in the knowledge at present existing, in a connected form, on this subject. That to the causes pointed out by a Committee of the British House of Commons,\* in 1817, namely, improper construction or material of a boiler and undue but gradual increase of pressure, they will be able to add others as important, and as fully proved as the former. Nor will any cause for alarm result from this extension, since it will be found that it is only ignorance of these circumstances which constitutes their danger, and that they may be prevented from occurring and remedied when they occur. It will be full time after the well-ascertained causes of explosion have been duly guarded against, to look for others more occult in their nature, if indeed there are such.

In the following report, the Committee propose to examine separately the circumstances which they consider as the proximate causes of explosions in steam boilers, and the preventives or remedies which have been proposed to meet them. Under each division of the subject they will make the suggestions or recommendations to constructors and others, which they base upon the previous discussion; and at the close of the Report, will present a project of a law for carrying into effect, in regard to steam-boat boilers, those recommendations which are of primary importance.

It will be observed thus, that while they do their duty to the arts by pointing out as far as their knowledge extends what they consider improve-

\* Charles Harvey, Esq., Chairman.

ments or valuable alterations, they do not propose to render imperative any measures but such as are required for public safety.\*

In submitting this project the Committee obviously do not entertain a doubt of the competency of Congress to legislate on the matters embraced in it. The several discussions in that body on the subject,† the recommendation of the President of the United States,‡ and especially the very detailed provisions of the bill recently proposed in the Senate, fully sustain them in this opinion. They consider the question now to be, not whether any regulations may be made, but how those to be made may be rendered most efficient and complete. For this completeness the very respectable Committees§ who reported the bill referred to, in the Senate of the United States, have expressed themselves anxious; and the labours of this Committee, so far from being an interference, will, no doubt, as far as they may be approved, be looked upon as forwarding the views thus expressed.

The good effects which have attended the adoption of partial preventives in England, and the excellent effects from the more complete ones in France, should urge us, as Americans, to do our part in preventing further destruction of life and property by these disastrous explosions. And while we apply means for this purpose, experience and reason both teach us that they will produce no undue or severe restraints upon mechanical skill or commercial enterprise, but rather that they will aid both, by increased confidence on the part of the public.||

The Committee propose to investigate the different causes of the explosions in steam-boilers under the following general divisions.

I. Explosions from undue pressure within a boiler, the pressure being gradually increased.

II. Explosions produced by the presence of unduly heated metal within a steam-boiler.

III. Explosions arising from defects in the construction of a boiler or its appendages.

IV. Explosions resulting from the carelessness or ignorance of those intrusted with the management of the steam-engine.

V. An examination of the particular cases of collapse of a boiler, or its flues, by rarefaction within.

*1. Explosion from undue pressure within a boiler, the pressure being more or less gradually increased.*

1. This is one of the most natural causes to look to as producing the bursting of steam-boilers, and one which, probably, is as frequently operative as any other. It might be supposed that with a safety valve always applied and a mercury gauge so easily applicable, the low pressure boiler should have been exempted from explosion. But such has never been the

\* This project is put forth with a view to free discussion, without which the Committee would feel entirely unwilling that it should be adopted. They propose, with this view, to distribute it as widely as possible, and invite especially a discussion of its provisions, in the Journal of the Franklin Institute.

† See Act regulating steam vessels, proposed in 1824, mainly founded on the action of the Committee of Councils of Philadelphia; and especially the report of Mr. Wickliffe, from a Select Committee of the House of Representatives, May 1832. [Pub. Doc. Rep. No. 478.]

‡ In the annual message for 1833.

§ The Committee on Naval Affairs. Hon. Samuel L. Southard, Chairman.

|| Professor Silliman, in an article on the safety of steamboats, has the following strong expression of opinion: "The boat which is first ascertained to afford absolute security will be a fortune to its proprietors."—Silliman's Journal, vol. XIX. p. 146.

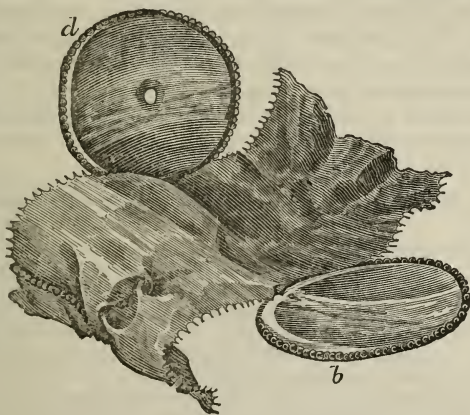
case, and we find a select Committee of the British House of Commons, in 1817, specially directing their inquiries to the cause above stated, as producing the disastrous explosions which, even at that day, called for legislative interference.

2. That a gradual increase of pressure can produce all the effects of the most violent explosions, may be inferred from many cases on record, attributed with probability to this cause; and was proved conclusively by the direct experiments of this Committee. In these latter, cylinders of copper and iron were violently torn asunder, the parts thrown from their places, scattering the materials of the temporary furnaces over which they had been heated, and of the fire, to considerable distances.\* There are also cases well made out in which a weak place in a boiler has acted as a safety valve, but such fortunate circumstances are not always to be looked for, and better methods have been devised of effecting the same object, than to imitate them by the use of thin plates. The idea stated to be current,† namely, that a boiler does not explode if duly supplied with water, is wholly untenable and highly mischievous in its tendency.

\* This effect is well illustrated by the rendering of a copper cylinder just referred to. The subjoined figure and extract are from the first part of the report of the Committee on Explosions, &c. p. 68. (Jour. Franklin Institute, vol. xvii. pp. 224, 225.)

“As before, nothing remarkable occurred previous to the instant of explosion, and the members of the committee, employed in the experiments, were engaged in observing the boiler at the instant it exploded. A dense cloud of smoke and flame, capped by steam, rose from the pit; the stones and combustibles were widely scattered, and the boiler was thrown, in a single mass, about fifteen feet from the furnace. The noise attending this explosion was like that from the firing of an eight inch mortar.

“The boiler was rent as shown in the accompanying figure, giving way in an irregular line, just above the probable water line on one side of the boiler, but not conforming to it. *d* and *b* were the lowest points in the two heads before the explosion. The



sheet of copper was torn from the heads, unrolled and irregularly bent, adhering to the heads for only a short distance near the top of each; and the heads were bent outwards. The thickness of the copper along the line of rupture varies from 0.25 to 0.35 of an inch, and the metal appears to have been highly heated at one end of the torn portion.”

† Replies to Circular of Com. on Explosions, &c. No. XII. Report of Thos. Bakewell, Esq.—“at a subsequent period and after the captain had conversed with some of those who contend that a boiler cannot burst with ‘fair play,’ as it is termed.”—To meet this prejudice, the Committee have chiefly selected their proofs from accidents which have occurred abroad.

3. We are warranted, then, in looking to the failure of the apparatus designed to prevent undue pressure, or to the misuse of it, as the cause of explosions of the most violent kind. The current of testimony is too strong to permit the former view to the exclusion of the latter. It has been too clearly shown that those who have charge of the steam engine sometimes not only neglect the means of safety provided, but actually render them inoperative. Not to multiply instances, the Committee refer to the following as entirely well made out, and in which the connexion between the misuse of the means of safety and the explosion is fairly to be inferred. First; That of a cast-iron boiler used in a sugar-house in Well-close-square,\* London, the mercury gauge attached to which was plugged up and the safety-valve purposely overloaded at the time of explosion. Second; The case of a steam tow-boat on the Rhone,† in France, when the safety-valves of the four boilers were fastened down, so as to be immoveable. Third; The explosion of one of Trevithick's locomotives,‡ when the safety-valve was kept down to raise steam at starting. Fourth; The explosion in the steam carriage of Messrs. Burstall and Hill,§ when in going over a soft piece of road, in which the coach laboured, the engineer kept down the safety-valve, by pressing upon the lever. And Fifth; The explosion of the boiler of the steamboat New England from a "pressure of steam, produced in the ordinary way, but accumulated to a degree of tension which the boilers were unable to sustain."||

4. If the apparatus devised for the low pressure boiler has been rendered inoperative, the high-pressure boiler has had to contend with peculiar difficulties. No gauge applicable to it has yet been brought into use. The open gauge must be of undue height, or cumbrous in its serpentine form; and the closed gauge requires great nicety in construction, and a correction for the temperature of the air enclosed in it. A graduated safety-valve would give the engineer desirable information, and has been to a certain extent used. The engineer of a locomotive engine, where the spring weighing machines are used with the safety-valves, has it in his power to ascertain at any moment, the pressure within the boiler.

He has it is true besides, the power of keeping the valve down even when the pressure within may be unsafe, but then he and his assistants would probably be the only victims of its abuse.

\* Minutes of evidence before a Select Committee of the House of Commons, &c. &c. by Geo. Dodd, Civ. Eng. Evidence of Mr. Braithwaite, Mr. Richter, &c. Also, Partridge on the Steam Engine.

† *Annuaire du Bureau des Longs*, 1830, p. 141. *Jour. Frank. Inst.* vol. v. p. 401. It is stated in the *London Jour. of Arts*, that the pistons of the engine had become fixed in the cylinders by being expanded more rapidly than these latter, and that Mr. Steele, the manufacturer of the engine, supposed the steam to be insufficient, and was induced by the desire to have his engine succeed, to adopt a device which resulted so fatally. *London Jour. Arts*, vol. xiii. p. 346.

‡ Minutes of Evidence, &c. Evidence of Mr. Chapman.

§ Reply to Circular of Com. on Explosions by L. Hebert, Esq. of London, No. II. See also the bursting of one of Hancock's boilers, from the fastening down of a safety-valve. *Lond. Mech. Mag.* vol. xviii., and *Jour. Frank. Inst.* vol. xi. p. 277.

|| The part marked with inverted commas is the conclusion drawn by an able committee who investigated the cause of this explosion. It is unpleasant to see in this case, how those concerned in the press of steam, were biassed in their views given to the committee and communicated, as the committee testify, as honest convictions, and without intention to deceive. The engine men were not injured by the explosion. The form of these boilers was no doubt defective, and one part of them will be commented on hereafter. The two boilers exploded almost simultaneously.—*Jour. Frank. Inst.*, vol. xiii. pp. 55 and 126.

5. The extraordinary and fatal increase of pressure which the Committee have above shown to be produced designedly at times, has at others been attributed to the adhesion of the safety-valve. A practical engineer, Mr. John B. Calhoun, has given a remarkable instance of this kind\* as occurring to a safety-valve on the boiler of the steamboat *Legislator*, then navigating the Hudson. The mercury-gauge indicating an undue pressure within the boiler without the raising of the valve, the engineer endeavoured first to raise it by a cord which passed into the fire-room: failing in this he went to the top of the boiler where the valve was, and moved the weight upon it towards the fulcrum, but without effect. He then applied his force at the end of the lever to raise it, when suddenly the valve opened with a loud report, and the flow of steam commencing lasted some time before the elasticity had diminished to its usual degree.

6. In this case, there can be but little doubt that the valve had corroded upon its seat or was fastened by the drying of oil, or other matter, to it. The carelessness of the fire-man who had charge of the boiler, and whose duty it was probably to raise the valve from time to time, is fully proved by his allowing the steam to get so high, that the rod of the mercury-gauge was against the boiler-deck, without giving notice to the engineer. Had not the latter observed, from the rapid working of the engine, that the steam was high, and investigated the matter, the lives of many would, no doubt, have been sacrificed.

7. The experiments made by M. Clement Desormest on the tendency of disks, when placed in front of an aperture, through which air is forcibly issuing, to approach it, led him to condemn the safety-valve entirely, and especially the disk form. This sentence does not seem to the Committee to be just,† since the tendency upward, under the most favourable circumstances to its action, is very limited in amount, and may easily be counteracted by a device, which will lessen the acting weight, when a safety-valve is raised. Besides, the proportion which the area of the disk bears to that of the aperture materially affects the amount of this tendency, and is, in practice, very much less than was used in the experiments of M. Clement. The ingenious experiments of M. Hachette and Messrs. Hopkins and Roberts of Manchester, have shown the truth of these remarks.‡ If

\* Account of an extraordinary adhesion of the safety-valve of the boiler on board the steamboat *Legislator*, on the Hudson. By the Engineer. Jour. Frank. Inst., vol. v. p. 355.

† Notice in Franklin Journal vol. iv. p. 97. See also explanations of the phenomenon offered by Jacob Perkins, Esq. in the same volume, p. 252, and in London Jour. Arts, vol. xiii. p. 275. By Doct. Hare in Jour. Frank. Inst. vol. ii. p. 58. By James P. Espy, Esq. in the same vol. p. 59, and by Asa Spencer, Esq. in the same vol. p. 61. also remarks on p. 203.

‡ In this view the Committee coincide entirely with M. Arago. See *Annuaire du Bureau des Long.* 1830, p. 157, and Jour. Frank. Inst. vol. v. p. 408. In fact the committee named in the next note did not sustain the deduction, above referred to in the text, remarking, in very guarded terms, that the limits within which the phenomenon occurs were then not sufficiently known, to decide upon the possibility of an accident from it.

§ M. Hachette who investigated this subject shows in a strong point of view the effect of the relative proportions of the disks. When one is not many times the other in size it is impossible to satisfy the conditions of the problem. *Annales de Chim. et de Phys.* vol. xxxv. p. 44, &c. The Committee who examined this subject in its relation to the Steam Engine, consisting of MM. Biot, Poisson and Navier, made an experiment in which with a disk, nearly six times the diameter of the opening, and a pressure of steam about 2.8 atmospheres, the tendency to adhesion when the disk was .01 of an inch from the opening, was but half a pound. *Annales de Chim. et de Phys.* vol.

however, this action were allowed to have full effect, by dimensions in the valve expressly intended to produce it, an increased area of valve would entirely obviate the objection. Different effective means of lessening the acting weight, on the rise of a safety-valve have been used or proposed, such as that employed by MM. Arago and Dulong\* in their experiments, on the elastic force of steam at different temperatures, or the very similar one, described by Mr. L. Hebert in his interesting communication to this Committee.† In them the weight rolls towards the fulcrum when the valve opens.‡ The Committee apprehend that this form, although very effective while in order, would tend by disuse to lose its power of action. They would prefer, in practice, a construction similar to the second form proposed by Mr. Hebert in which the lever being curved effects the same object, while the weight is not required to be moveable. They intend to recommend a suitable form of lever of this kind.

The practice of passing the stem of a safety-valve through a stuffing box, as it is calculated entirely to defeat the object of the valve, should never be allowed. In fact the more open to inspection all the parts of the apparatus are the better. If it is necessary to carry off the steam from that which the engine-man has the control of, it can be accomplished without resort to packing.

9. There can be no doubt that the form of the safety-valve materially influences the certainty of its action. Although the disk-valve was early recommended, the nicety of workmanship required to make it tight has limited its use, and perhaps the experiments of M. Clement have produced a prejudice against it. The cone, which is in common use, may be more easily tightened when perfectly fitting the seat; but this very fact is an objection to it. No pressure can cause the disk valve to prevent the escape of steam, if the valve and seat be clean, unless they have been ground to fit. The Committee adopted this form of valve in their experiments,§ and in no instance was undue adhesion observed. Throughout their experiments, the pressure of the steam corresponding to the opening of the valve with its different weights, was noted by the steam-gauge, or by the temperature of the water within the boiler. No means were used to keep the valve in other than what might be considered fair working order, but when, from the action of dirt, it had become leaky, the grinding upon the seat was very easily performed, and restored its efficiency. Two valves of the same form were used, and the comparison of the calculated pressures due to the weight upon the valve, with the observed pressures at which the valve rose entirely, or leaked so badly as to require additional weight, uniformly gave the former in excess. The average ratio in the experiments was 1 to 1.035, the former number representing the observed, and the latter the calculated, pressure.

xxxvi. p. 70. In the experiments of Messrs. Hopkins and Roberts, with an excess of pressure in the effluent air of .05 of an atmosphere, over atmospheric pressure; the total tendency to adhesion at its maximum, was but .005 of an atmosphere, with an opening of  $2\frac{3}{4}$  inches, and a disk of six inches in diameter. With a disk of eight inches in diameter the total tendency was increased from 32 oz. avoirdupois, to 48 oz: and with disks  $4\frac{1}{2}$  in. diameter and under, no such tendency was manifested, the aperture of efflux remaining the same. Manchester Trans. vol. v. N. S. and Jour. Frank. Inst. vol. x. p. 188.

\* *Annales de Chimie et de Phys.* vol. xliii.

† See replies to circular of Com. on Explosions, No. XI.

‡ In that of MM. Arago and Dulong there was also an arm projecting on the opposite side of the fulcrum from that on which the weight keeping down the valve was placed; upon this a weight rolled from the fulcrum on opening the valve.

§ Report of Com. on Explosions, part I. pp. 71, &c. Jour. Frank. Inst. vol. xvii. p. 228.

10. These conclusions are sustained, in a general way, by the success which has attended the recommendations of the select committee of the British House of Commons. The law, based upon their investigations, requires that there should be two safety-valves upon every boiler, one of which is out of the control of the engineer,—and further provides a penalty for the overloading of either valve, by any person whatever.\*

11. In addition to two safety-valves, the regulations for the safety of the steam engine in France, require two fusible plates or plugs, of suitable diameter, to be attached to every boiler. These plugs are intended to act by the heat of the inclosed steam, and to give way when it has reached a certain point. In the application of them which we are now considering, they are exposed to a pressure corresponding to the temperature, and in order to prevent them from giving way as they verge towards the fusing point, they are covered with wire, or with perforated disks or gratings of metal.

12. This mean of safety was made the subject of elaborate experiments by this Committee.† The result was, that when alloys of tin, lead, and bismuth, such as are used for fusible plates, are exposed to heat and pressure, parts of them soften at temperatures below that at which the entire plate would become liquid. Being exposed to pressure, these fluid parts are forced out,‡ leaving a less fusible mass. In one case described by the committee, this operation was carried so far before the plate gave way, that from a plate melting at  $254^{\circ}$  to  $275^{\circ}$  Fahr., was produced a mass fusible only at  $312^{\circ}$  to  $345^{\circ}$ . One part of the alloy which oozed out was found to melt at  $223^{\circ}$  and another at  $233^{\circ}$ .§ To this action a fusible plug

\* The regulations relating to the safety-valves of steamboat boilers, are as follows:

That every such boiler shall be provided with two sufficient safety-valves, one of which should be inaccessible to the engine-man, and the other accessible to him and to the persons on board the packet.

That the inspector shall examine such safety-valves, and shall certify what is the pressure at which such safety-valves shall open, which pressure shall not exceed one-third of that by which the boiler has been proved, nor one-sixth of that which by calculation it shall be reckoned to sustain.

That a penalty shall be inflicted on any person placing additional weight on either of the safety-valves.

Of twenty-three witnesses, practical engineers and others, examined by the Parliamentary Committee, seventeen recommended explicitly the additional safety-valve, out of the control of the engine-man.

† Report of the Com. on Explosions, of the Franklin Institute, Part I. p. 23. "V. Inquiry in relation to plates of fusible alloys." Jour. Frank. Inst. vol. xvii. p. 74.

‡ This fact, but to a limited extent, seems to have been noticed by M. Gualtier de Claubry, who did not, however, follow out the suggestion. *Receuil Industriel*, 1829.

§ The entire series of conclusions from these experiments, which formed one of the most interesting branches of the Committee's investigations, are as follows:

"The conclusions deduced from the foregoing experiments, on metallic alloys, may be thus stated.

"1st. The impurities of common lead, tin, and bismuth, are usually not such as to affect materially the fusing points of their alloys.

"2d. When mixed in equivalent proportions, tin and lead formed alloys, not presenting the characters of distinct chemical compounds, in definite proportions. The alloys between the range of one equivalent of tin, to one of lead, and one equivalent of tin to six of lead, varied considerable in the interval between the temperature of commencing to lose fluidity, and that at which a thermometer, immersed in the solidifying metal became stationary. These different alloys produced nearly the same stationary temperature in a thermometer plunged into the solidifying metal.

"3d. Fused metal plates covered by a perforated metallic disk, and placed upon a steam-boiler, show signs of a fluidity at the disk, before the steam has attained the

would be also exposed, and the committee are of opinion that no method of application in which the pressure acts upon these compounds, can be efficient in practice.

In the experiments referred to, the plates being thin, were generally burst by pressure; not, however, acting precisely as thin plates of copper or iron would have done, but being partially softened by heat.

13. While the Committee deem it very desirable that a convenient steam gauge applicable to high pressure boilers should be devised,\* they consider that until this is done, a substitute should be furnished in a graduated safety-valve, marked with numbers expressing directly in pounds to the square inch the bursting† pressure of the steam, and within the control of the engine-man. This would act as a convenient, and, for practice, a sufficiently exact method of knowing what he ought always to be informed of, the bursting pressure in the ordinary working of the boiler. Besides this, however, there should be a lock-up valve, for the original weighting of which there should be a proper responsible agent, and which should be capable of being raised by the engine-man, but not of being kept down. With a valve of this kind of sufficient dimensions, of proper form, and duly weighed, the Committee believe that danger from gradually increasing pressure might be entirely avoided.

A thermometer suitably graduated and passing into the steam or water of the boiler, would prove under ordinary circumstances, a useful gauge, and may be conveniently applied as described in a subsequent part of this report.

14. With a view to meet the dangers which have been discussed in this section, the Committee would make the following recommendations, the means of carrying out the principal of which, by law, will be found suggested at the close of the report:—

temperature of fusion of the alloy of which the plate is composed. This fluid metal oozes through the perforations in the disk, and the plate thus loses much of its substance before finally giving vent to the steam.

“4th. The under parts of the plate are not kept from fusion by a protecting film of oxide there formed.

“5th. The thickness of the plate is not important, provided only that it is sufficiently strong to resist the pressure of the steam at temperatures below its point of fusion.

“6th. The temperature at which the plates are cast, and the rate of cooling of the cast metal, do not affect the temperature at which the plates give vent to steam.

“7th. The effect stated in conclusion third, is explained by the nature of the alloys used, which are formed of portions of different fluidities; the more fluid parts, are forced out by the pressure of the steam, leaving the less fusible. These latter, in general, are burst, not melted.

“8th. By pressure in a receptacle provided with small openings, this effect of separating the differently fluid portions of an alloy, may be imitated.

“9th. Fusible alloys, used to indicate the temperature of any part of a steam-boiler, should not be exposed to the pressure of the steam; at least not in such a way that the separation of the differently fusible constituents of the alloys may be effected.”—Report of Com. on Expl. Part I. p. 34, and Jour. of Frank. Inst. vol. xvii. p. 84.

\* The Committee regret that the hydrostatic safety-valve of Mr. Ewbank has not been brought into use. It would answer, by a slight modification, as a gauge, and no doubt can exist of its being applicable to the stationary engine. The oscillation of the liquid may interfere with its operation on board of steamboats, but to what extent the Committee are not prepared to say. See description and figures Jour. Frank. Inst., vol. ix. p. 64, and, vol. x, p. 2.

† This term is used to signify the excess of pressure of the steam within, over atmospheric pressure, in contradistinction to the *working* pressure, which is used to express the total elastic force of the steam.

*First.* That every boiler be provided with two safety-valves, each of which shall be competent to discharge the steam, made in the ordinary working of the engine. The first of these valves should be graduated by the maker of the engine, and have stamped upon the lever by which it is weighed, the bursting pressure at which it will open, by calculation, when the moveable weight is placed at the several notches. The pressure corresponding to the last notch to be equal to the bursting pressure, under which the engine is to work. The second valve to have a weight fixed immoveably upon it, the pressure of which upon the seat, together with that of the atmosphere upon the valve, is equal to the working pressure of the engine. This valve should be so arranged as to admit of raising, but not of placing additional weight upon it. To this end it should be inclosed. The rise allowed by the inclosure should rather exceed half the radius of the valve seat.

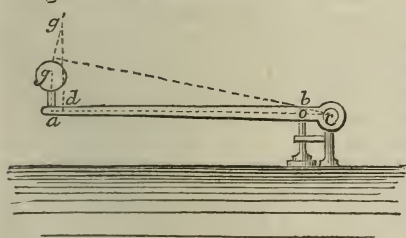
*Second.* The Committee recommend to constructors the disk valve. The diameter of the disk should not exceed once and a half that of the valve seat, as a less ratio than this will leave sufficient margin, and any sensible tendency to close from the effect of the issuing current will certainly be avoided.

*Third.* That a cord be attached to the lock-up valve, by which it may be raised at the same time with the free valve. And that the working of each be ascertained at least every two hours.

*Fourth.* That an open mercury-gauge be provided for each boiler of every engine not carrying more than two atmospheres of working pressure. The height of the mercury to be indicated by a float which shall truly mark upon a graduated scale the bursting pressure in inches.

For high-pressure boilers they recommend the thermometer, graduated to show the pressures corresponding to the temperatures of saturated steam, as a convenient gauge.

*Fifth.* That the lever of the lock-up valve be bent upwards at the end, so that in rising it shall relieve the valve of part of the weight. A suitable proportion for such relief would be about one-tenth of the pressure derived from the weight, and the height of the bend above the lever should be regulated to meet this.



The lever would have a form similar to the annexed. The part *a g*, which is turned up, may be straight or otherwise. The adjustment should be made so that *d c* is nearly nine-tenths of *a c*. *g* being the centre of gravity of the ball, lever, &c. will lie a little out of the centre of the weight, towards the fulcrum.

*Sixth.* As there can be no doubt that the competition in regard to speed is, or has been, a strong temptation to an undue increase of pressure by engineers or firemen, it should be expressly prohibited by law.

II. *Explosions produced by the presence of unduly heated metal within a steam-boiler.*

15. In a properly constructed steam-boiler no part of the metal is exposed to the direct action of the fire without being immediately in contact with water: the temperature of the metal cannot be raised above that of the water, and is thus determined by the weight upon the safety-valve.

When, from any cause, the metal is not so circumstanced, it becomes unduly heated, and danger may arise from two sources; first, the metal is weakened and rendered less capable of resisting even ordinary pressure; second, it serves as a reservoir of heat ready to bring into existence highly elastic steam, whenever water shall obtain access to it.

16. The first of these positions rests upon the basis of direct experiment, and is, the Committee believe, generally admitted.\* Their experiments on the strength of materials have, however, developed a curious fact in regard to the strength of malleable iron, namely, that it slowly increases at first with an increase of temperature, and attains its maximum at a temperature above that at which any of the steam-engines used in practice, are worked. Above this maximum, the decrease of strength is very rapid; so as to be, at a red heat, but about one-sixth of that at ordinary temperatures. Copper, on the contrary, is weakened by any increase of temperature above the lowest, which was tried, namely, 32° Fah. The fact just stated in regard to iron, is interesting in its application to the proof of iron boilers, by the water-press, and as showing the great, and rapidly increasing, danger from diminished strength, as the metal is raised above the temperature of maximum strength.

17. Secondly the heated metal serves as a reservoir of heat to furnish highly elastic steam, when water is in any way brought into contact with it. That highly heated metal can produce steam, rapidly, has hitherto been a controverted position. In the experiments of Klaproth, successive drops of water thrown into an iron spoon, originally heated to redness, vaporized the more rapidly as the metal lost heat. In the experiments of Perkins and others, larger quantities of water in highly heated metallic vessels, vaporized very slowly. It is true that by injecting water into an iron cylinder, heated to redness, Mr. Perkins found a sudden increase of elasticity; but he attributed the effect to the hot and unsaturated steam which the cylinder contained, and through which the ejected water passed.† The Committee found that the temperature of clean iron at which it vaporized drops of water most rapidly, was 334° Fah.‡ The development of a repulsive force is so rapid above this temperature that drops which required but one second to disappear, at the temperature of maximum vaporization, required 152 seconds when the metal was heated to 395°. One-eighth of an ounce of water introduced into an iron bowl, three-sixteenths of an inch thick, and supplied with heat by an oil bath, at the temperature of 546° Fah., was vaporized in fifteen seconds, while at the initial temperature of 507° Fah., that of most rapid vaporization under these circumstances, it disappeared in thirteen seconds. The cooling effect of the water upon the metal is here strikingly shown, by the increased temperature to which the latter has to be raised at the beginning of the experiment, in order to give the most rapid vaporization. A further illustration of the same kind is afforded by comparing the temperature giving most rapid vaporization, when the metal of the bowl is supplied with heat by a good and a bad conductor, or imperfect circulator, as by a bath of tin and one of

\* In the minutes of the Select Committee of the House of Commons there is a statement by Mr. John Steel that cast-iron is strongest at the temperature of 300°, but it is not supported by reference to experiment.

† Franklin Journal, vol. iii. p. 418. Lond. Mechs. Mag. or Jour. Frank. Inst. vol. ix. p. 348.

‡ Report of Com. on Explosions. Part. I. Vaporization of drops." Reply to Query VI. Jour. Frank. Inst. vol. xvii. p. 90.

oil. With a rough surface, an iron bowl one-quarter of an inch thick, vaporized one-eighth of an ounce of water most rapidly by introducing it when the metal was at 555° Fah., the bowl being in an oil bath; while in a tin bath the corresponding temperature was 508° Fah.

18. By carrying out this idea we have the clue to the action of water thrown, in considerable quantities, upon heated metal; and find, accordingly, that when the water was increased sixteen times, or from one-eighth of an ounce to two ounces, the temperature of most rapid vaporization was raised from 460° to 600° Fah.; the surface of the metal being smooth, and the heat supplied through tin. Now, although differences in the mode of applying heat will alter these temperatures, it is clear that they rise rapidly with the quantity of water thrown upon the metal. In the case where as much water was thrown into an iron bowl as it could contain without loss by ebullition, the temperature of greatest vaporization, upon a clean surface, was 600° Fah. or about 200 degrees below a red heat, and would, according to analogy, have been higher if on a rough, or oxidated, surface.\*

19. These observations explain the direct experiments made by the Committee, in which highly elastic steam was always rapidly produced by injecting water into a boiler heated to bright redness.† In one case, by the injection of ten ounces of water the elasticity of the steam was raised, in less than two minutes, to upwards of twelve atmospheres, and a miniature explosion produced. The remarks made in this experiment show, that wherever the water slid along the bottom of the boiler the spot of contact was for the instant blackened, by the sudden reduction of temperature, and this under the unfavorable circumstance of the introduction of a limited quantity. The bottom of the boiler in these experiments was clean, but not bright. The time required for the generation of explosive steam under these circumstances does not yet admit of calculation, but this may be affirmed with certainty, that a safety-valve which, under ordinary circumstances, may be adequate to carry off the excess of steam produced in a boiler, will prove wholly insufficient for its escape, in the supposed case.

20. These experiments are entirely supported by well authenticated cases of explosions in steamboat boilers. Mr. Bakewell‡ gives an instance in the case of the steamboat *Grampus*, where six cylindrical boilers, each thirty-eight inches in diameter, exploded simultaneously. The engineer had discovered that they contained very little water, and had suddenly thrown in a plentiful supply. When one of the boilers of the steamboat *Car of Commerce*§ exploded, it was well known that the pumps had not furnished the requisite supply of water; and just after an attempt to remedy this difficulty, the head of one of the boilers was thrown off. This boiler was, it seems, differently constructed from the others, with which it was connected, and which did not give way.

The first of these cases is distinctly made out, and the second cannot be resolved into a matter of opinion, as may perhaps be done with other acci-

\* Report of Com. on Expl. &c. Reply to Query IV. "Vaporization of increased quantities of water." Jour. Frank. Inst. vol. xvii. p. 160.

† Ibid. Reply to Query II.

‡ Letter to Sec'y. of Treasury, communicated to Com. on Expl. Reply to Circular of Com. No. XII. Also, Letter of Thos. J. Haldermann, No. XXI. of Replies.

§ Letter of Thos. J. Haldermann, No. XXI. of Replies to Circular, &c.

dents, which, though there is a strong probability that they are to be traced to this cause, the Committee refrain from quoting.

21. It is, of course, not assumed that an explosion must necessarily follow the presence of heated metal; for other circumstances must conspire to produce such a result. Facts indeed, may be brought to show that, in certain cases, these attendant circumstances have been accidentally wanting, or have been judiciously avoided.

As examples of this, may be taken instances mentioned by Col. Long\* in which timber on the top of cylindrical boilers has been known to take fire, though considerably remote from any fire-flue. Those to which Mr. Bakewell† has been an eye witness, when the steam has been so highly heated after leaving the boiler, as still to burn the hempen packing of the steam cylinder, and where wood contiguous to the boiler has been fired. Similar incidents not followed by explosions have occurred in the mines of Cornwall,‡ and in one of the Liverpool and Dublin packets.§ Examples of the second kind will be referred to subsequently.

22. With such a powerful agent present, as the highly elastic steam which it has been proved may be rapidly generated by the heated metal, it might have been supposed that no other cause for explosion would have been looked for, than the action of this steam. The case is, however, otherwise, and the Committee must turn aside from their direct course to examine briefly the theory which assigns the production, and subsequent destruction of hydrogen gas, as the cause of the explosion. According to this view, the water thrown upon the metal is decomposed, and hydrogen gas evolved; or a similar decomposition of the steam, by the hot metal, takes place. This hydrogen, becoming mixed with oxygen, is ignited by the red hot metal, and an explosion ensues. The difficulty of furnishing oxygen for the hydrogen to combine with, has lately been met more satisfactorily by Mr. Perkins, than it had been by any preceding theorists. He asserts that air is frequently drawn in by the operation of the forcing pump, and is thus accumulated in the boiler. The primary hypothesis, in regard to the production of hydrogen, having been fully disproved by the experiments of this Committee, there is no necessity for examining the minor ones; it may be well, however, to observe, that if air were introduced into a highly heated boiler, containing hydrogen in too large a quantity either to combine explosively, or silently, with the oxygen of the air, that element would be taken up by the heated metal; and that gases cannot enter, and remain without mixing with the steam, and being carried out with it. In the experiments of the Committee which have been referred to,|| water was thrown upon the bottom of a boiler, heated to orange redness, without being decomposed. In fact the scale of oxide existing upon the bottom prevented the decomposition of water, by enfeebling the affinity which would

\* Replies to Circular, &c. No. II.

† Replies, &c. No. XII.

‡ Mr. Perkins states on the authority of Mr. Moyle, that a ladder accidentally resting upon the top of a boiler, was set on fire by heat communicated from thence. Franklin Jour., vol. iii., p. 417, or Lond. Jour. Arts, vol. xiii., p. 95.

§ Evidence, before Com. of House of Commons, 1817. Hazard on Explosions. Frank. Jour. vol. iii. Ewbank on Explosions. Jour. Frank. Inst. vol. x.

|| The reader should refer to these, that he may see the care which was taken in them. A negative result requires so much more caution than a positive one, that more time was devoted to those experiments in order to make them satisfactory, than the Committee deemed warranted by the importance of the subject. Report of Com. on Explosions, Part I. p. 61, &c. Jour. Frank. Inst. vol. xvii. p. 217.

produce it. This boiler was carefully cleaned, and in good working condition; a condition in which no one need be told, a boiler has not a bright metallic surface.

23. Carburetted hydrogen does no doubt exist at times in a boiler, in greater or less quantities, from the decomposition of oil, or of vegetable substances introduced to stop leaks, or to prevent deposits, but nothing warrants the idea that it can accumulate and mix with air, so as to be dangerous.

In furnaces where coal is used as a fuel, it will be seen in the sequel that gas, if prevented from escaping by the closing of a damper, may collect, and may possibly be a source of danger.\* The ignition of a mixture of coal gas and air in a furnace has been known to destroy it,† as also of a mixture of gas from resinous wood and air; but these are cases altogether foreign from the subject under discussion.‡

24. The explosion of the steamboat *Enterprise*, on the Savannah river, is said to have occurred at the instant the boat was struck by lightning. This has been advanced as confirming the hydrogen hypothesis; but no inference can fairly be drawn from an accident, in regard to which the circumstances are so little known. If there was hydrogen present, there must have been unduly heated metal, and the direct action of electricity on the nonconductors around the boiler, may have so displaced it as to bring water upon the heated metal, and thus to effect an explosion. This, like the other supposition, is mere hypothesis. It is certainly, however, quite as contrary to analogy, that an electric spark should pass through any part of a space, like the interior of a boiler surrounded by a conductor, and thus explode a mixture of hydrogen and oxygen within it, as that it should shatter this extensive conductor by its direct action. The Committee consider the circumstances of this case as too illy defined to draw any inference from it, certainly not one which is contrary to sound theory, by which they mean general induction from numerous well observed facts.

25. Another case has been urged with much more appearance of directness in the testimony. A boiler in the Union rolling mills at Pittsburgh burst with a tremendous explosion; a cylinder with one of the heads attached, was thrown out of the works, and rising to a considerable height in the air, fell nearly two hundred yards from its former bed. A passenger in a boat which was near at the time, describes a stream of fire, as issuing from behind the boiler, which, according to the hypothesis under discussion, was a stream of burning hydrogen. It is almost needless to remark that if hydrogen had been the cause of the explosion it would not have burned in a stream behind the empty boiler as it rose; the observation is, however, perfectly well explained by Doct. Jones,§ by the stream of light which appears to attend every luminous substance moving rapidly, on account of the duration

\* Explosion in the Gold mines as given by John Taylor, Esq. *Philos. Mag.* vol. i.

† M. Arago states this to be the fact on the authority of M. Gay Lussac. A furnace was thus destroyed at the Paris arsenal. *Annuaire du Bureau des Long.* 1830, p. 197, and *Jour. Frank. Inst.* vol. vi. p. 54.

‡ See the case of an explosion of a sheet-iron drum attached to an anthracite stove, with its explanation by Prof. Hare. *Jour. Frank. Inst.* vol. vi. p. 337. Pine shavings were used to kindle the fire, the gas from which, mixing with the air in the pipes and drum, produced an explosion, when the flame from the kindled shavings rose into it. Refer also to the explosion of the bellows of a smith's forge. *Silliman's Jour.* vol. xxiv. p. 192.

§ *Jour. Frank. Inst.* vol. iii. pp. 70, 71. "Editor on explosions in Steam Boilers."

of the impression upon the eye. That the boiler was red hot, there appears no doubt.

26. From this digression the Committee return to the pursuit of their subject. They conceive that it has been fully established, that the presence of unduly heated metal is dangerous, both from the weakness of the material, and the possibility of its producing highly elastic steam. They, therefore, proceed to examine the probable causes leading to this result, and which have been suggested either in the communications made to them or in other documents, and the proposed remedies for, or precautions against, the danger.

[TO BE CONTINUED.]

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*On the metallurgic treatment of the Galena of Bleyberg in Carinthia. From the French of M. BOULANGER, Candidate, Engineer of Mines.\**

A very simple and commodious method of treating galena, is pursued at Bleyberg, in Carinthia, the theory of which process forms an interesting subject of enquiry, and it was this which induced me to make the following analysis of the products of the various operations pursued at these works. I shall first give a short description of the operations, extracted from the journal of a tour made in this country in 1832-'33, by MM. Gruner Harlé and Foy.

The mineral employed at Bleyberg is galena, found in veins in limestone, of which two kinds are chiefly worked; in one of the beds the galena is accompanied by pyrites and blende, with traces of silver; the other contains pyrites likewise, but rarely blende, and encloses sulphate of baryta and molybdate of lead without a trace of silver.

The two ores are dressed with much care, and mingled in such proportions as to be of good quality; for in order to be worked to advantage, they ought to yield 65 or 70 per cent. in a small assay. When prepared for smelting, they contain a little pyrites, blende, sulphate of baryta and limestone.

The operations are conducted in a reverberatory furnace, eleven feet long and four and a half broad, (figs. 1, 2, 3,) parallel to the longer side of which is the fire place. The bottom is inclined at an angle of 25°; the fire place, formed of brick arches, at about 36°. The flame and smoke escape through the chimney, situated at the side of the charging hole. The bottom is formed of clay, old bottoms and refuse pounded together in a dry state; it is slightly cylindric in its whole length, forming a kind of trough in which the lead flows.

When the bottom is well beaten, it is fired for five or six days, the heat being increased towards the last, to soften it, and it is then smoothed.

Each operation for the reduction of the galena consists of three parts; 1. roasting, 2. raking, 3. the operation termed *pressen*, in which the lead is acted upon by air and charcoal.

1. *Roasting*. The furnace is charged with three quintals, twenty lbs.† of the washed ore of two different sizes and qualities, the mean product of which should be at least 70 per cent. lead. When the foregoing

\* Translated at the request of the Committee on Publications, from Ann. des Mines, 3rd Serie, T. VII., by J. C. Booth.

† The quintal is 221 lbs. avoirdupois, English, and the French lb. about 2lb. 3oz.

operation is complete, the furnace is suffered to cool for a quarter of an hour, and then charged with the ore, which is spread uniformly by an iron rake. The heat is maintained at incipient redness to avoid the fusion of the sulphuret, and ought to be lower, in proportion to the purity of the material, because its tendency to fuse is diminished by the infusible nature of the matrix. It is stirred up every half hour by an iron rod, the handle of which rests on a hook suspended by a chain; not however, too frequently, for that would retard the roasting.

Fig. 3.

Fig. 2

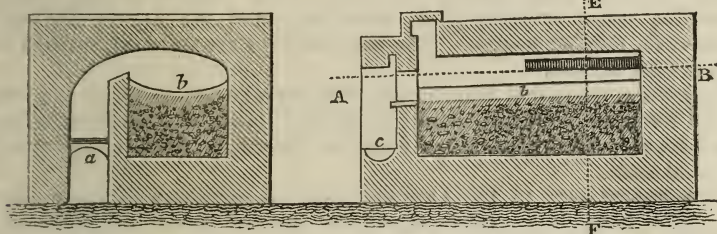


Fig. 1.

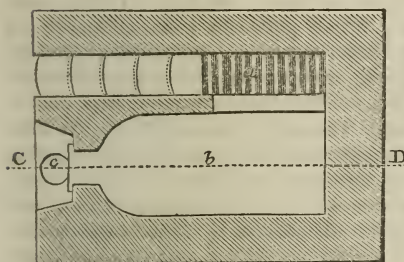


Fig. 1. is a horizontal projection along A, B, of Fig. 2. Fig. 2, a vertical section through C, D, of Fig. 1, and Fig. 3, a vertical section through E, F, of Fig. 2. *a*, represents a furnace place arched with bricks, *b*, is the sole, and *c*, the basin to receive the lead.

This first operation lasts from four to five hours,\* during which the temperature is gradually raised, and that without inconvenience, since the fusibility of the material diminishes in proportion to its oxidation; besides which an elevation of temperature causes a re-action, producing lead which often begins to flow out in a couple of hours. The heat ought not, however, to be carried so far, that the lead comes red from the furnace. This is called virgin lead, and is received into an iron vessel placed beneath the charging hole.

2. *Raking or Stirring.* While the roasting is going forward, the fire is increased to cause a more energetic re-action of the materials, causing the lead to flow abundantly. The workman frequently stirs the mineral by spreading it out, and again bringing it into a heap, and at length pushes it down to the bottom of the furnace, where the heat is more intense, at the same time surrounding the charging hole with blazing wood. This second part gives with the first, two-thirds of the lead, and when, notwithstanding the stirring, the lead ceases to run, the next operation follows.

3. The *Pressen* is only performed every second smelting, because it produces but little lead and requires much fuel, besides which the ore is diminished in bulk. When the second operation is completed, the refuse, called the rich scrapings (*krätze*), is taken out; fresh ore is added and treated like

\* According to Villefosse, six to seven.—TRANS.

the first; the first refuse is then added to the last, they are spread over the bottom of the furnace, and several shovels of live coals taken from the fire place, scattered over it. The workman mixes the whole by means of the iron rake, pushes it to the bottom of the furnace, increases the fire and stops the charging hole with blazing faggots. The lead flows out, and upon its ceasing, the workman again spreads out the pile for roasting, after which he adds more charcoal and brings the whole again into a heap. This alternate oxidation and reduction is continued till there are no longer traces of lead.

This operation lasts three hours, and when completed, the residue, termed the "poor scrapings," is taken out, and the bottom beaten to prepare it for another charge. The poor residues are stamped, washed and mingled with the ore.

One *poste*, composed of two charges, lasts twenty-one hours, during which one and the same workman performs all the labor, who afterwards rests for two *postes*. Each *poste* gives from four quintal, forty lb. to four quintal, sixty lb. of lead.

We now pass over to the examination of the products of these operations. The roasted ore taken out of the furnace before being stirred, is composed of a slightly caked, sandy mass, showing only a fusion of the lead, when subjected to a high heat in an earthen crucible. With black flux it gave 50 per cent. metallic lead, which gave no trace of silver by cupellation. This substance is very heterogeneous, presenting oxides, unchanged galena, and metallic lead, the greater part of which may be separated by stamping and sifting. The powder thus obtained, was boiled with water, which dissolved sulphuric acid, lime, and oxide of lead; the lime was present in larger quantity than was necessary for saturating the sulphuric acid, and to this excess was probably owing the solution of lead with sulphuric acid. But did sulphate of lime pre-exist in the mass, or was it not rather afterwards generated by the action of water? In order to ascertain this, I boiled water with a mixture of sulphate of lead and caustic lime, and found that all the acid was dissolved, together with a certain quantity of lead, which varied with the quantity of lime and water employed. The acid might, therefore, have existed in the state of sulphate of lead, and only combined with lime through the interposition of water; but since the sulphate of lime is more fixed than that of lead, the same might have occurred in the dry way, and the salt of lime have been formed in this case likewise; it is hence impossible to say in what state of combination the sulphuric acid existed.

Boiling acetic acid extracted from the remainder, insoluble in water, lime, oxide of lead, and protoxide of iron.

From this remainder, hydrochloric acid disengaged sulphuretted hydrogen. Having ascertained that silica was dissolved, which would be in a gelatinous state, I thought it advisable to extract this by means of liquid potassa, before the use of hydrochloric acid; the decomposition of the sulphurets might be apprehended by this means, and possibly a small portion of oxide of lead, found in solution in the potassa, arose from decomposed sulphuret, for an excess of sulphur was found by analysis; but without doubt the greater part of the oxide pre-existed in the substance in the state of oxisulphuret, and could not be taken up by the acetic acid.

The residue insoluble in potassa was treated with hydrochloric acid, and the liberated sulphuretted hydrogen received into ammoniacal nitrate of copper; an analysis of the resulting sulphuret gave the quantity of sulphur

contained in the metallic sulphurets; the hydrochloric solution contained iron, zinc and lead.

The residue insoluble in the hydrochloric acid contained a little lead, which was taken up by weak nitric acid, and added to that obtained by sifting. Lastly, roasting the last residue gave a little sulphur from its loss of weight, and there remained only sulphate of baryta, as was ascertained by an analysis with carbonate of potassa in a silver crucible.

According to this analysis, the roasted ore is composed of

Oxide of lead,	-	-	-	-	-	0.310
Sulphuric acid,	-	-	-	-	-	0.023
Lime,	-	-	-	-	-	0.042
Oxide of iron,	-	-	-	-	-	0.004
Sulphuret of lead,	-	-	-	-	-	0.225
“ iron,	-	-	-	-	-	0.022
“ zinc,	-	-	-	-	-	0.069
Sulphur,	-	-	-	-	-	0.002
Silica,	-	-	-	-	-	0.016
Sulphate of baryta,	-	-	-	-	-	0.034
Metallic lead,	-	-	-	-	-	0.233

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0.980

It follows from this analysis, that the roasted ore is principally composed of metallic lead, its sulphuret and oxide, for even supposing all the sulphuric acid to be in the state of sulphate of lead, still there would be but 8 per cent. of it; now the roasting process, in heaps, generally gives a larger quantity of this sulphate; it is the more remarkable that the roasting in a reverberatory furnace gives rise to so small an amount, because it is performed in this case at a very low temperature, exposed to a current of air that ought to be highly oxidizing; in fact, the very inclined position of the fire place creates a current of air, which mingles with the flame above the fire, independently of the one below it; besides, in order to enter the furnace, the flame is obliged to pass through an opening only four inches in height, (an arrangement analogous to the smoke-consuming furnaces of M. Lefroy) necessarily causing an eddy and a consequent mixture of the air and combustible gases, which ought to deprive the latter of every deoxidizing property; notwithstanding these circumstances, so favourable to the production of a sulphate, but little is formed. It appears to me explicable in the following manner.

The first effect of the roasting is to produce oxide of lead, which tends to unite with the sulphuric acid generated; the production of this sulphate ought therefore to be in proportion to the quantity of free oxide; now in a reverberatory furnace, the oxidation takes place superficially, and the oxide is in contact with the unchanged sulphuret beneath it; a reaction occurs, with the consequent production of metallic lead, while very little oxide is formed; it is hence easy to perceive that too frequent raking would produce a large quantity of oxide, part of which would be converted into sulphate, because the reaction could no longer as easily occur; and we have seen, that at Bleyberg, the surface is renewed every half hour.\*

In roasting in heaps, the ore is put in layers alternating with charcoal, where reaction would only take place between the substances in the same

\* The theory may be stated thus: the basic sulphate of lead forms with the unchanged ore a pasty mass, a lower sulphuret than galena, from which the lead flows, by a conversion of a part into a higher sulphuret.—TRANS.

layer, but as all are equally exposed to the oxidizing current, they are soon roasted in an equable manner, and the production of sulphate ought consequently to be considerable. In fact, by comparing the quantity of sulphate produced by roasting the same ore in heaps, or in a reverberatory furnace, we shall find these suppositions verified; at Holzapfel, for instance, roasting in heaps produces 19 per cent. of sulphate, in a reverberatory 8 per cent.; at Pezey, in the one case, 65 per cent. of sulphate is obtained, while the other operation produces none. Roasting in reverberating furnaces offers therefore, great advantages, since it generates the least possible amount of sulphate.

By exposing the roasted ore to a strong heat, a reaction is caused between the oxide and the sulphuret, with the production of a fresh quantity of lead, an operation termed stirring (*Bleirühren*).

The resulting "rich scrapings" have absolutely the same appearance as the roasted ore, containing, like it, metallic lead imbedded in the mass, and through the whole are perceptible brilliant scales of galena. Assayed with black flux, they give 51 per cent. metallic lead, which leaves, by cupellation, a button of unalloyed lead.

An analysis of this substance, made in the same manner, gave the following results:

Oxide of lead,	-	-	-	-	-	0.305
Sulphuric acid,	-	-	-	-	-	0.037
Lime,	-	-	-	-	-	0.116
Oxide of iron,	-	-	-	-	-	0.012
“ zinc,	-	-	-	-	-	0.038
Sulphuret of lead	-	-	-	-	-	0.061
“ iron,	-	-	-	-	-	0.029
“ zinc,	-	-	-	-	-	0.074
Silica,	-	-	-	-	-	0.028
Sulphate of baryta,	-	-	-	-	-	0.051
Metallic lead,	-	-	-	-	-	0.183

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0.934

An examination of the above analysis will show that this substance differs but little from the roasted ore, for it is nothing more than a product of roasting, except that the oxides are present in larger quantity from the nature and length of the process. By comparing the lime with the sulphate of baryta, it will be perceived that this base has nearly doubled. Can this be attributed to the want of homogeneousness of the substance, or may we not rather suppose, that a small quantity of lime has been added during the process, (which is sometimes done,) either to saturate the sulphuric acid, produced in abundance by continued roasting, or to diminish the fusibility of the substance exposed to a more elevated temperature during the stirring process?

The "rich scrapings" yield no more lead by a simple reaction, because a part of the oxide undoubtedly forms with the sulphuret, an oxisulphuret, on which the oxide does not act; it is, therefore, necessary to have recourse to charcoal for reducing the latter and liberating the sulphuret; by again roasting it, the newly generated oxide acts on the sulphuret, and thus by successive reductions and oxidations, the scrapings are exhausted of nearly all the lead. The charcoal has also the effect of rendering the mass porous and offering channels to the metallic lead imbedded in the mass for flowing into the iron receivers; indeed, both the preceding substances contained much metallic

lead, while the "poor scraps" now remaining, are almost wholly destitute of it.

This residue differs from the preceding in not containing metallic lead, and in presenting a more homogeneous appearance. Heated with black flux, it yields 5.7 per cent. of lead, which gives a button of silver by cupellation, much larger than that of the rich residue.

It contains no sulphuric acid except in combination with baryta; the analysis was conducted by first treating it with acetic acid, and then the operation was continued as in the preceding materials; there was found as in the preceding cases, it is composed of:

Oxide of lead,	-	-	-	-	0.020
Lime,	-	-	-	-	0.318
Protoxide of iron,	-	-	-	-	0.062
Oxide of zinc,	-	-	-	-	0.154
Sulphuret of lead,	-	-	-	-	0.050
"    iron,	-	-	-	-	0.038
"    zinc,	-	-	-	-	0.138
Silica,	-	-	-	-	0.056
Sulphate of baryta,	-	-	-	-	0.148
Metallic lead,	-	-	-	-	0.012
					<hr/>
					0.996

It is apparent from this analysis that the charcoal had the effect of destroying the oxide and sulphuric acid; the sulphate of baryta is, however, unaltered, which probably arises from the great resistance to decomposing agents, which natural bodies present.\*

It is also worthy of remark, that this last product encloses a considerable quantity of sulphuret of zinc, the more surprising as blende is generally the first to be roasted.

Another not less remarkable anomaly relates to the silver contained in the ore, the quantity of which is small, but while the lead obtained during the first process, gives no indication of it, it is found in the other products, particularly in the last. We must, therefore, conclude, though contrary to what generally occurs, that the silver is concentrated in the last products.†

This refuse yields no more lead, because the great amount of oxidized matter prevents the ulterior oxidation of the sulphurets; instead, however, of rejecting them, they are stamped, washed and mixed, with the crude ore.

From the preceding it may be gathered that the process pursued at Bleyberg is very simple, consisting in the transformation of a part of the sulphuret into oxide, in causing these to act on each other to produce lead, and lastly, in setting the sulphuret again at liberty to enable the fresh oxide to act upon it.

During the whole of this treatment, the substances are merely softened, and preserve their sandy state, which is favorable to the successive oxidations and reductions that could not be performed on liquid or pasty masses. Care is also taken at the commencement, to heat moderately to avoid smelting the galena, and to raise the temperature gradually, and only

\* The sulphate of baryta is at all times difficult of decomposition, and should be in immediate contact with the decomposing agent, which may not be the case in the above operation. Would it not, however, be decomposed if a sufficient quantity of charcoal were present?—TRANS.

† It is to be regretted that the author has not presented us with an accurate analysis of the metallic lead obtained during the different stages of the process, as it might give us valuable hints in regard to theory and practice.—TRANS.

in proportion as the sulphuret diminishes, for then the fusion of the substances is not to be feared.

As already stated, the roasted ore, or the scrapings, subjected to a bright red heat in a clay crucible, did not undergo fusion, which must be attributed to the sulphate of baryta, and to lime, for probably the lime added during the process, is peculiarly adapted to that purpose. This is directly opposed to the ideas of M. Tournet (in a note in *Ann. des Mines*, 3e, Série, T. II. "Théorie du traitement de la galène au réverbère,"), who asserts that sulphate of baryta is added in Carinthia, to promote the fusion of the gypsum which is generated. The assertion is incorrect, for the heavy spar is found in the matrix, and if ought be added, it is lime, not however, for the purpose of rendering the gangue fusible, for it is important to prevent it, and by this very means the end is attained, for, according to Berthier, (*Ann. des Mines*, 3e Série, T. II.,) the sulphates of lime and baryta do not form a fusible combination.

There remains 7.3 per cent. lead in the "poor scrapings," the amount of which, retained by the different combinations it forms with foreign substances, ought of course to increase with these. A tariff is employed at the works regulating the loss of lead according to the productiveness of the ore.

When the ore contains 82 per cent. the loss should not exceed 2 per cent., 80, 3; 78, 4; 76, 5; 74, 6; 72, 7; 70, 8; 68, 9; 66, 10; 64, 11; 62, 12; 60, 13.

The poor residues were formerly treated alone, with a loss of 20 per cent. The workmen receive  $2\frac{1}{2}$  kreuzer, (2 sous) for every pound they obtain beyond the tariff, and pay 5 kreuzer for every pound wanting. The table shows that the loss increases in rapid proportion, as the quantity of ore diminishes, the consequence of which is, that only very rich ores can be employed in this process, and indeed they only receive such as give 50 per cent. in a small assay.

In order to bring the different ores to a convenient state of richness, they are subjected to preparatory mechanical operations, and very carefully washed; hence the work would be expensive with a high price for labour; at Bleyberg, however, a day labourer receives a very moderate compensation. It were impossible to make the ore productive in many places, even supposing wages to be very low; it is when the metallic substances accompanying the lead, such as the blende and pyrites, contained silver, in which case all these substances should remain in the ore. It follows, therefore, that the process of Bleyberg ought to be limited to certain localities, where, as in Carinthia, the contents of silver amount to almost nothing.<sup>1</sup>

With regard to the advantages derivable from the Carinthian method, they are considerable, when taken in connexion with economy of fuel, as may be shown by a comparison of it with the analagous process pursued at Poullaouen. At Bleyberg eleven to twelve cubic feet of wood are consumed in obtaining the quintal of lead. According to a treatise of M. Baillot, they obtained at Poullaouen, in 1824, from an ore containing 60 per cent. lead, only 42 per cent., showing a loss of 30 per cent.; but this loss is not real, for a part of the lead is obtained on an ore hearth, though it then requires another operation. The loss at Bleyberg for ores containing 60 per cent. is only 13 per cent. In order to obtain one quintal of lead, forty-seven to forty-eight cubic feet of wood are consumed, or four times as much as at Bleyberg. Again, they destroy six pounds of iron instruments per quintal; at Bleyberg, on the other hand, only one-fifth of a pound; this arises from the

formation of much sulphate during roasting, which, being afterwards decomposed by the charcoal and iron, converts the latter into sulphuret. The Carinthian method possesses, therefore, great advantages, being convenient and easy of execution, requiring only one workman during a *poste* of twenty-one hours, the consumption of fuel and loss of lead being inconsiderable. But only small quantities can be operated on in this manner, for in twenty-one hours the amount of lead produced, does not exceed four and a half or five quintals, French. At Poullaouen, they obtain in the same time, or even in eighteen hours, twelve to thirteen quintals.

It is probable that the employment of a large furnace in this method, would destroy its advantages, the facility of labour and economy of fuel; in fact, at Poullaouen, the greatest expense for fuel is incurred during the reducing process, when the temperature must be very high, although the furnace is considerably enlarged by a diminution of the substances. At Alsau and Holzapfel, they likewise employ the Carinthian method, operating only on small quantities.

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## Physical Science.

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### ESSAYS ON METEOROLOGY.

#### No. IV.

#### *North East Storms, Volcanoes, and Columnar Clouds.*

If all other proofs were wanting, our great N. E. storms of six or eight hundred miles in diameter, from N. E. to S. W., and of unknown extent from S. E. to N. W., would afford us an undeniable proof of an upward vortex. These storms always set in from near the N. E. and terminate near the west. So we have proof positive, that the wind near the surface of the earth, is always blowing both east and west of the storm towards the storm itself. I have observed these storms for many years, and I have never known but two to terminate with the wind from the eastern quarter, and then the anomaly was soon explained in both instances, by another storm coming on in less than forty-eight hours. But even in these cases, after the termination of the first storm, the wind was very gentle, nearly calm.

The wind always commences from the N. E., some hours (from ten to forty) before the beginning of the rain or snow, and does not change till near the end: however, it is believed that the upper clouds during all this time, continue to come from the S. W.

They certainly do so till they are concealed from view by the lower clouds, which generally form a short time before it begins to rain, and the moment the lower clouds break away a little, near the end of the storm, the upper clouds are seen moving in the same direction. Besides, I have more than once got a peep through the lower clouds, during the progress of a storm, and discovered thick, dense, clouds above, coming from the S. W.

I have also seen instances of a strong wind at the surface, directly opposite to the motion of dense clouds above, which were evidently not very high, from their great velocity, and I afterwards learned that at the same moment there was a very great rain about one hundred miles distant, in the direction towards which the lower wind was blowing. The extent, however, of these rains, I did not learn. It must depend upon future and more extended observations, to learn whether the outward motion of the air in

the upper part of the vortex, extends beyond the boundary to which the inward motion of the air below reaches.

On the ocean, it is known that these storms are attended with immense swells reaching beyond the agitation of the atmosphere. This effect is probably much more dependent on the diminished pressure of the atmosphere on the ocean under the vortex, than on its horizontal velocity. For a fall of three inches in the barometer will cause a rise of the water of more than three feet to produce equilibrium, and as the waters would move in all directions towards the point of least pressure, their momentum would cause a rise two or three times this quantity independent of the effect caused by the friction of the air. How far the reciprocation of this wave would extend, I am not at present able to say. I think I have read of considerable elevations of the water, at one end of the lake of Geneva, which were evidently not produced by the wind blowing over the surface of the lake in a direction favourable to such an elevation; if there was a spout passing, near the time of the elevation, it would account for the phenomenon. Indeed, if the spout should even pass over the middle of the lake, and the barometer should fall there three inches, it would cause such a swell that its reciprocations would reach its extremities after the spout had passed away, and thus these swells would appear to take place in the midst of a calm, and so be apparently unconnected with the wind. Mr. Dalton informs us that the surface of Lake Derwent is sometimes agitated, when no wind can be perceived, in so violent a manner, that it exhibits large waves with white breakers. The phenomenon is called a bottom wind; but the cause of it is utterly unknown. Lake Wetter, in Sweden, is affected in a similar manner.\* The theory of upward vortices shows how such an effect might be produced.

Even as to the barometer itself, I have not seen any theory which is able satisfactorily to account for its great and sudden falls. It cannot be the diminished pressure which takes place from the deposition of rain, for if ten inches of rain were to fall so suddenly that the air would not have time to rush in and restore the equilibrium, it would not cause the barometer to fall one inch.

Indeed, so great has been the difficulty on this point, that the author of the *Art. Physical Geography*, in the *Edinburgh Encyclopædia*, thinks these depressions are caused by the destruction of large portions of the air in the higher regions of the atmosphere by electricity acting on the combustibles which ascend there from the earth. I need hardly add that this phenomenon is a corollary from the theory here advanced.

It has been thought also, that the centrifugal force of the wind blowing over the curvature of the earth's surface, might cause these great depressions of the barometer. But if we suppose the whole of the air in motion with a velocity of one hundred miles an hour, and calculate its centrifugal force according to the principles laid down before, its gravity would be diminished when the wind was west, only about one hundred thousandth of its whole weight, which would cause the barometer to fall .0003 of an inch; and if the wind is east, it will readily be perceived that its gravity will be increased to the same amount. The theory will also account for the great depression of the barometer, which is known sometimes to accompany the action of volcanoes.

On the 19th of December, 1821, a violent eruption commenced from the old volcano Eyafjeld Jokkul, in Iceland, which had been quiet since the year 1612. On the very day of the commencement of the eruption the

\* *Ed. Ency. Art. Physical Geography.*

waters of the rivers which descended from the surrounding mountains, were considerably increased. All over Europe dreadful storms of wind, hail and rain succeeded the commencement of this eruption. On the 24th, particularly, extraordinary devastations were experienced in very distant parts of Europe, and generally, wherever the hurricane appeared, deluges of rain accompanied it. At Genoa, and many other parts of Italy, the storm is described as particularly severe, (wind S. and S. E.,) many parts of the country and the roads being entirely submerged; and the next day, the 25th, the barometer fell unusually low all over Europe, including Great Britain. Now it is highly probable, that the eruption of the volcano threw out immense quantities of vapour, and if so, the condensation of this vapour would heat up the atmosphere by the evolution of its latent caloric, as was explained before, and this heated air would rise and spread out in all directions; and a vortex being thus established and kept up by the action of the volcano, both by mechanical force and by a diminution of specific gravity, the air rolling out on all sides above, and pressing in on all sides below, a general rain would be the consequence, and this rain might spread out so far from the centre of action, as to reach even the south of Europe in five days. The barometer continued to fall, in Iceland, from the day before the appearance of the volcano, till the twenty-sixth day after it was at the lowest in different parts of Europe, and two days after the prevalence of great storms in Italy and France. During all this time the volcano was in active operation, and even as late as the 23rd of February, it emitted smoke greatly resembling steam of boiling water. The whole quantity of rain which fell from the 19th till the 24th, must have been very great; for even as far south as Genoa, the air, for several days previous to the 24th, when the great tempest occurred there, had been filled with thick vapours, which vented themselves in torrents of rain, and the wind blew from the south with intense violence. This south wind would bring from the Mediterranean an immense quantity of vapour, to be condensed when it entered into this vast upward vortex. Let us suppose then, what is certainly within bounds, that five inches on an average of rain, fell over the surface of Europe, from the 19th till the 24th, or the morning of the 25th; and in Paris, where the flood was not as great as in many other places, there fell 6.4 inches. From the principles explained before, the caloric given out by the vapour in condensing into rain, would heat the whole atmosphere  $11.4^{\circ}$  for every inch of rain, or in the present case 57. degrees. And as the mean temperature of the air was certainly below  $32^{\circ}$  the expansion due to this increase of temperature would be more than  $\frac{57}{480}$  of the whole, which would cause the air to stand at its surface five and a half miles higher over the region where the rain had been deposited, than in surrounding countries, provided it was forty-five miles high before the deposition, and none had flowed off.

This last supposition, however, cannot be true, for the moment it began to swell up by expansion, it would begin also to flow off, and the depression of the barometer would be in proportion to the quantity rolling off above, greater than that which ran in below towards the point of least pressure. This difference would be considerable for two reasons: first, the air below would not begin to run in until the air above had rolled out; for a mere expansion and swelling up of the air would not diminish its gravitation; and second, its resistance would be less from friction than the lower air would experience rubbing along the surface of the earth. Besides, its outward motion from the centre of the vortex, would not so much be a rolling

down an inclined plane in consequence of its being swelled into a greater perpendicular height, as a shoving out of the surrounding air at an elevation of about three and a half miles and upwards, where the air in the vortex would overbalance the surrounding air, as will easily be conceived by any one who will consider the effect of an up-heaving of the atmosphere by expansion. From all these causes facilitating the outward motion of the upper air in the vortex, it is probable that at least one half of the quantity of air elevated in the vortex above the surrounding air, by expansion, would flow off; and if so, it would cause a depression of the barometer, within the region of the rain, of more than one inch and a half. And this corresponds with the depressions given in many places.

This depression would cause a velocity of the air at the surface of the earth, on the outside of the vortex, towards the centre of rarification, of 114 miles per hour, if there was no friction; but as the friction at the surface of the earth is very great, the velocity would probably not be more than one half this quantity, or fifty-seven miles per hour. This velocity would not be sufficient to produce the overflowing of the sea at Genoa, Leghorn and Trieste, but if to the force of the wind, we add the diminished pressure of the air along the northern shore of the Mediterranean and of the Adriatic, and the increase of the pressure of the air on the outside of the storm, by the rush of the air outwards above the rise of waters, there might be quite sufficient to produce the disastrous effects which spread consternation over so much of the southern part of Europe.

Was the remarkably warm winter of 1821 and 1822, in all the north of Europe, caused by the immense quantity of latent caloric given out during these great rains, together with the southern winds which prevailed in consequence of the upward vortex of air over Iceland during this whole winter? At St. Petersburg, dreadful floods of rain repeatedly occurred during the winter, and the snow had entirely disappeared by the first of February; and even beyond Tobolsk, warm winds prevailed, and generally in the interior there was no snow. And on the 2d of March, the Dwina was free from ice at Riga.\*

If this were the only fact on record, of rain accompanying volcanoes, it ought in this case, to be considered accidental and unconnected, but nothing is better established than the connexion of volcanoes with rains, from their very frequent concomitancy. Indeed, Baron Humboldt, speaks of the mysterious connexion of volcanoes with rains, and adds, that they sometimes on breaking out change dry seasons into rainy in South America. This connexion will be considered mysterious no longer. It may here be added as a reason why volcanoes do not always produce rains, that in the most unfavourable state of the dew-point, rains cannot be produced.

Volcanic eruptions are sometimes attended with tornadoes. In the Island of Sumbawa, eastward of Java, a most dreadful volcanic eruption commenced from the mountain of Tomboro on the 5th of April, 1815, and was most violent on the 11th and 12th. Out of a population of twelve thousand persons only twenty-six escaped destruction. Violent whirlwinds swept away men, horses, cattle, and every thing which came within their vortex, tore up the largest trees, and covered the neighbouring seas with floating timber, that had been scorched in passing through the flames.

These volcanic vortices sometimes carry up the drops of rain high enough to freeze them. The Rev. W. B. Clarke, says in the Magazine

\* See Phil. Journals of 1822.

Nat. Hist. vol. vii, page 300, "that Mr. Kelsall, who was an eye witness of the great eruption of Etna in 1809, writes thus: At fifteen minutes past 9 A. M., April 1st, a quantity of dense vapour or smoke proceeded from two rents, which rose to a considerable height in the atmosphere, before serene, was dilated, and formed a black cloud above 2000 paces in diameter, which presently discharged a copious shower of large hail stones, on the red hot lava. In the same page he says, that during an eruption of a volcano in Iceland, in 1793, not only did rain fall in torrents, but also hail in showers.

Mr. J. R. Jackson, in his *Aide-Memoire Du Voyageur*, says, "I have seen in the planes of Agra, Hindostan, Lat. 27°, enormous columns of sand, sometimes thirty at a time, several feet in diameter, rising perpendicularly out of sight, and followed frequently by a shower of large hail stones, containing such a quantity of sand in large grains, that in filling a goblet with this hail, when it was melted, there was a sediment of sand almost half an inch thick.

From these accounts it is manifest that hail is sometimes produced by an upward motion of a column of air, both with and without volcanic agency. That snow is produced, and even not permitted to fall down in the region of the upward motion when that motion is very rapid, is abundantly proved by the following facts:

In Scoresby's *Arctic Regions*, vol. I, page 404, the author says, "About 10 h. the snow abated, and several ships were seen about three or four miles off. As all these ships were sailing on the wind, it was very easy to ascertain the direction of the wind where they were. Two ships bearing N. E. from us had the wind N. E.; two bearing E. at E. or E. N. E.; two bearing S. E. had the wind S. E. while with us it blew from the N. W.

In each of these places a fresh breeze prevailed; but in some situations where there happened to be no ships, there appeared to be no wind at all. The clouds above us at the time were constantly changing their forms, and showers of snow were seen in various places at a distance." At another time, he says, "while a gentle breeze from N. prevailed with us, a heavy swell from the S. S. E. came on, and a dense black cloud appeared in the southern horizon, which rapidly rose into the zenith and shrouded one half of the heavens. The commixture of this dense air with the cold wind from the N. produced a copious discharge of snow. When the snow ceased, (though we were nearly becalmed,) we observed several ships a few miles to the south-eastward under close-reefed topsails, having evidently a gale of wind, blowing in the direction of the swell. In about two hours the southern wind reached us, and as we stood to the eastward, gradually increased to a gale. Previous to this storm the barometer fell three-fourths of an inch in twelve hours. Now as the wind in both these storms blew towards a particular point from all sides round, it must have blown upwards at and over that point, and hence the snow was not permitted to fall there, but fell at "various places at a distance."

It is equally clear, that a strong gale could not blow towards Captain Scoresby in sight of him for two hours, before it reached him, without blowing upwards at some point between him and the ships seen labouring in the gale.

A remarkable circumstance, which I think can only be explained on the supposition that the cloud mentioned moved upwards, is related in the next page. He says, "my father was engaged on a particularly fine day in admiring, from an eminence of 2000 feet on Charles Island, the extensive prospect, when the rapid approach of a small cloud attracted his attention ;

When it reached the place where he was setting in a calm air, a torrent of wind assailed him with such violence that he was obliged to throw himself on his body and stick his hands and feet into the snow, to prevent himself from being hurled over a tremendous slope which threatened his instant destruction. The cloud having passed, the air again became calm, and he immediately descended." Now this is just the effect which a large mass of air would produce by moving upwards rapidly, from being of less specific gravity than the surrounding air, which is too plain to need demonstration.

This cloud was probably formed in the following manner: Air at the surface of the ground below became heated, as it always does in clear, calm days, some degrees hotter than the air a little above the surface, and thus produced an unstable equilibrium, so that the least agitation would cause an upward motion to commence at the point of greatest heat, especially if that point contained a higher dew point, as it generally does. As soon as this motion commenced, other air rushed in below, and the higher and longer the column of heated air became, the more rapid would the upward motion become, and finally, after the upper end of the column was as many hundred yards high as the temperature of the air on the ground was above the dew-point in degrees of Fahr., the cold produced by the expansion of the air, would begin to condense the vapour and form clouds; and still as other air rose to that elevation it would begin to condense likewise, and thus the base of the cloud would remain at the same elevation, while the cloud would go on increasing in perpendicular height above. This is the kind of cloud which is formed almost every clear day in the summer when the dew-point is not very low, but never forms when it is over cast. When the air is calm, if these clouds are observed carefully when they are forming, they will be seen to increase in perpendicular height while their bases remain at the same level. They rise in the form of pyramids or cones, with dense, well-defined outlines, as white as snow. If they do not meet with an upper current causing their tops to lean in the direction in which it is moving, they rise perpendicularly, and as they are broad enough even at their tops to lift up before them a considerable mass of air, it sometimes happens that in reaching strata of air highly charged with vapour it lifts them to a higher elevation and causes a thin streak of cloud to be formed at some distance above the top of the columnar cloud. This streak so formed I have denominated a *cap*. It is generally a little curved convex above and concave below, and as it moves slower upwards than the columnar cloud, the latter overtakes it and passes through it. Meanwhile the cap appears like a thin vapour spread over a mass of snow. Sometimes when a columnar cloud is very strong and rapid in its ascent a second and even a third cap is formed, with similar appearances. When this happens, rain from the cloud is certain. First, however, the top of the cloud is seen to change its dense and well-defined appearance and become hazy. This is a sign that the cloud is about to rain, and in a few minutes, if the cloud is favorably situated, rain will be seen descending from its base. These appearances are all best seen when the base of the cloud is a few degrees above the horizon. The top of the cloud as it hazes is generally, in this climate, carried off by the upper current towards the N. E. and forms that feathery cloud which is so different in appearance from all other clouds. It is the highest of all the clouds except the tops of these columnar clouds, which generally rise through it.

In passing through it the columnar clouds generally form a very dense cap, and are sure to haze and rain soon after their passage. After they

begin to rain they soon cease to rise; but other columns spring up contiguous to them, generally on the S. W. side of them, as far as I have observed, and as theory seems to indicate, and go through the same process of cap-forming, hazing and raining as the parent cloud.

These new columns when they first make their appearance I have denominated *sprouts*. This name is not inappropriate, for these sprouts are evidently generated, or at least assisted in their growth, by the parent column, in the following manner. As the parent column rises into the upper current of air, which generally comes from the S. W. or W. S. W. its top is made to lean towards the N. E. or E. N. E., but by its inertia it causes the current there to run a little slower, and so the column which may be about to form behind it towards the S. W. finds less difficulty in rising, and preserves a more erect position, and thus can attain a greater elevation. Hence, the first attempts of columnar clouds to rain are generally failures, because their tops are generally shaved off or pressed over towards the N. E., and thus dissipated without raining: each succeeding cloud in its wake finding a stiller air in its upward motion attains a greater elevation. Finally, one reaches a height sufficient to produce rain, and then a new source of power is called into action, powerfully aiding the formation of sprouts. This is the descending rain cooling the air below the cloud, and causing it by its greater specific gravity, and also by the weight of the drops of rain, to move outwards in all directions from the centre of the rain.

Now as the air all round the parent cloud is running in at the base of the cloud and below towards the cloud, this air is obliged to rise up over the stratum of cold heavy air, pressed outwards around the borders of the shower, and thus its upward motion is increased; and as the dew-point is more likely to be higher on the south side of the cloud than on the north, sprouts will on that account be more likely to form on the south than on the north. To see the formation of sprouts to the greatest advantage then, the cloud should be to the north of the observer.

If these theoretical deductions are correct, and as far as observation extends it does not contradict them, it would follow, that the progress of rain may be from a northern direction, though the upper current may be constantly carrying the hazy cloud formed from the tops of all these columns towards the east. Further observations are wanting on this point.

I would recommend that gentlemen residing in mountainous districts, where the clouds sometimes form on the sides of the mountains, should ascertain the perpendicular height of these clouds at their base, and see whether they are one hundred yards high for every degree of Fahr. which the temperature of the air is above the dew-point at the moment of their formation.

If gentlemen have no means of taking the dew-point directly, the following method will be found equally correct in ascertaining the height of the base of these particular clouds, at any time of the day, for the height varies every hour. Swing a thermometer (Fahr.) rapidly in the air to avoid the effect of radiation, note its temperature, then cover its bulb with a wetrag and swing it as before until it sinks as low as evaporation can make it, then divide one hundred and three times the difference of these temperatures by the wet bulb temperature, the quotient will be the height of the base of the clouds in question, in hundred yards. For example, suppose the dry bulb is  $56\frac{1}{2}^{\circ}$  and the wet one  $51\frac{1}{2}^{\circ}$ , then the base of the clouds will be 1000 yards high. This height is calculated on the supposition that air cools at  $4^{\circ}$  Fahr. in

ascending to a height where the barometer would be one inch lower than at the surface of the earth, and  $4^{\circ}$  more for every additional inch. If this latter law is not strictly correct, the height of the base of the cloud in question will vary accordingly, and the law itself may be accurately investigated by this method, for the precise degree of refrigeration necessary to condense vapour at a particular dew-point is known, after making an allowance for the expansion of the vapour itself and the fall of the dew-point on this account. As the discovery of a method to ascertain by the thermometer, the height of a particular kind of cloud easily distinguishable from all others, is a matter highly curious in itself, independent of its connexion with the theory here advocated, it will no doubt receive that immediate attention which it deserves.

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## Franklin Institute.

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### COMMITTEE ON SCIENCE AND THE ARTS.

#### *Report of Committee to try experiments with Spark Arresters.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, by experiments, the apparatus for stopping the sparks from issuing from the flues of Locomotive Engines, submitted in competition for the premium offered on behalf of the Newcastle and Frenchtown Turnpike and Rail Road Company, REPORT:—

That, from the plans submitted in competition for the offered reward, they selected three of the most promising, which they recommended the respective inventors to put in order for trial; at the same time they informed the other competitors that theirs also would be tried, if they requested it.

Through the liberality and kindness of the Beaver Meadow Rail Road Company, and the Philadelphia and Trenton Rail Road Company, the Committee have been favored with the use of the engine of the former, and of the road of the latter for making their experiments. One of the plans selected having been withdrawn, and none of the others claiming the privilege of a trial, there remained but two to be subjected to a practical test, viz: one invented by Jas. P. Espy, Esq. and the other by Mr. S. Gerhard.

The one by Mr. Gerhard, consists of a series of revolving fan wheels placed horizontally one above the other near the top of the chimney or smoke pipe, the wheels or fans were placed nearly in contact one above the other, having just sufficient space to admit of motion independently of each other, and the twist of the fans reversed in the middle one, so that its revolution should be in the opposite direction from the other two. The revolving motion to be produced after the manner of a smoke jack, by the current of air and steam passing up the chimney.

This apparatus was first put upon the engine and the fire attempted to be made, but it was found that owing to the too small capacity of the passage through the fans, the firing was difficult and tedious, and that it was impossible to keep up the steam for a moderate velocity of the engine and tender. The effect in arresting the fire sparks was rather unexpected, as not a single spark was seen to make its escape, although care was taken to use such fuel as would furnish them in the greatest profusion. This result could only be ascribed to one of the three following causes, either the ope-

ration of the fans had been effectual in beating back and destroying the sparks, or as the engineer who accompanied the Committee supposed, the obstruction to the draft being great the steam was necessarily so damp as to extinguish them, (and being in the night time they were invisible,) or what was considered highly probable, the obstruction was so great as to prevent the creation of an upward current sufficiently powerful to raise the sparks to the top of the chimney, and that any other obstruction operating in the same degree, would be attended with the same results. Accordingly, at a subsequent trial, a piece of sheet iron eight inches wide was secured across the top of the smoke pipe leaving an opening on each side three and a half inches wide, with the intention of making about the same amount of obstruction as had been caused by the before mentioned fans. The result of the experiment was nearly similar. The obstruction in the latter case was evidently, from other indications, not quite so great as in the former, and a very small number of sparks occasionally made their appearance. Whilst the committee acknowledge that their experiments go no farther than to show that the favorable results obtained by the inventor, previously to his submitting it to the examination of the Committee, and that obtained by the Committee as above mentioned, may have been owing rather to its efficacy as a *draught obstructor*, than to any good principle of action as a spark arrester, they can see no good reason for advising the inventor to incur the further expense of constructing one of larger dimensions, being persuaded that one of sufficient capacity to allow a free passage of the smoke and escape steam, would be attended with little or no impediment to the sparks.

The apparatus, called a draft-increasing chimney cap, invented by J. P. Espy, Esq., is of sheet iron, in the form of a cone, and is placed upon the top of the smoke pipe, with its axis horizontal and its lower side pierced about midway to receive the upper end of the pipe. The base is open with the exception of a wire-gauze covering, which is intended to retain the sparks within the cap. It is intended to turn upon a swivel and be governed by a vane, so as always to present the apex of the cone towards the wind; the intention of which arrangement is to create a partial vacuum at the base of, and within the cone, to compensate for the obstruction consequent upon the use of the wire-gauze. The Committee upon trial, found that this apparatus did produce the effect of increasing the draught to some extent, but although the gauze used was of the finest kind in use, No. 19, or 19 meshes per inch, yet the sparks found their way through in sufficient quantity to be troublesome. How far the draft-increasing property of this cap may operate, to compensate for the resistance of the gauze, when that shall be of sufficient fineness to effectually prevent the escape of sparks, the Committee have not the means of judging with any degree of precision, but they incline to the opinion that the compensation would not be complete without such an arrangement as would render the apparatus inconvenient if not unmanageable, particularly on roads which require the pipe to be dropped for passing under bridges. An objection arises from the circumstance of the sparks, dirt and water, when any such escape, being thrown backward, and consequently more likely to incommode the engineers, than when discharged from the top upward, and all around the sides. There seems, likewise, a want of some means of disposal of the sparks arrested, as they are necessarily retained against the gauze until they become so much reduced by combustion as to be forced through it, and likewise of a trap or valve to remain open when the draught is not urged by the exhaust steam. Upon the whole, the Committee are of the opinion that this arrester

does not come within the terms and conditions of the offered premium, and though they confess, that the trials have not been sufficiently numerous and diversified to enable them to speak with certainty as to its comparative merits, yet they feel constrained to say, that they do not perceive how the objections already alluded to, can be so far removed as to bring it into competition with one or two which have been since invented.

The thanks of the Committee are due to Messrs. Garrett and Eastwick, for their kindness in keeping the locomotive, at their own risk, for the accommodation of the Committee.

By order of the committee.

August 11, 1836.

WILLIAM HAMILTON, *Actuary.*

## Mechanics' Register.

### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1836.

*With Remarks and Exemplifications by the Editor.*

(CONTINUED FROM p. 195.)

59. For *Sawing with a Band Saw*; William Carey, Poughkeepsie, Dutchess county, New York, February 17.

The patentee claims as his invention, "the band saw running on two wheels, and the arrangement of the machine in which it is to operate." For the validity of which claim, see our remarks upon the patent of Benj. Barker, p. 112 of the present volume; every remark respecting which applies fully to the present patent.

60. For *Cannon for firing chain shot*; Edward Gordon, Hingham, Plymouth county, Massachusetts, February 17.

A double barrelled cannon is to be made, one vent discharging each. A ball is be put into each gun, the two being connected by a chain of sufficient length to admit of this. The guns are to diverge a little, in order to stretch the chain before the balls reach their intended object. There is not any claim made, but the patentee descants on the use of his invention, and the destructive effects of balls so connected, as though chain shot had never been used. Now it certainly behooves a man, before he attempts to improve a system of any kind, to acquire some knowledge of what has been previously done, for, when science and interest have long been combined in order to obtain the best results, it rarely happens that an indifferent person will stumble upon any great improvement, all vulgar adages to the contrary notwithstanding.

We do not know that chain shot have been fired from double barrelled cannon, nor do we believe that they ever will. We offer the following opposite quotation from "L'Allemand's Artillery." "The Annals of Paris and Vienna alone, are crowded with contrivances, all curious in their way, but offering models that do more credit to the imagination than to the judgment of their authors. Among a thousand inventions, or fancied improvements, it is difficult to find a single one that has not already been made and

condemned; and even if it be new, it cannot be admitted into a system until it has been submitted to practice during the course of a war."

61. For a *Machine for hulling Clover Seed*; John B. and William F. Poague, Lexington, Rockbridge county, Virginia, February 17.

A conical stone is to revolve is a corresponding hollow cone of the same material. The mode of fixing, driving, &c., are all quite antique; and the claim is to the "before described machine;" which claim may be perfectly correct, if by the before described machine, we are to understand a machine which has been repeatedly before described.

62. For a *mode of fastening Mail Bags, &c.*; Ira Atkins, Hanover, Grafton county, New Hampshire, February 17.

There is to be a lock, with a bolt, shot forward by a key in the usual way, but to the end of the bolt is to be hinged a flat plate of iron, which is one of a series hinged to each other, and forming a chain, or flat strap, each plate has a tongue on it which is to shoot into a staple; a row of such staples being fixed on one side of the bag, and passing through openings on the other side. The claim is to the whole arrangement, with the exception of the ordinary lock bolt. The contrivance appears to us to be one which will be more troublesome than useful.

63. For a *Mortice door latch*; William Coover, Erie, Erie county, Pennsylvania, February 12.

This mortice latch, or bolt, presents no feature of novelty, nor is any part of it claimed. It consists merely of a bolt with a zigzag spring behind it; the bolt being contained in a suitable case, and having a tumbler, and handle, by which it is to be acted upon.

64. For a *Spark Extinguisher*; Abraham McDonough, City of Philadelphia, Pennsylvania, February 17.

In this spark extinguisher there is to be a lining of sponge within the cap which constitutes the upper part of the chimney, and this lining is to be kept wet by the percolation of water through small tubes in the bottom of the trough, which is fixed at the upper edge of the cap; there is to be a water trough also at the lower end of the cap, into which sparks are to fall. The description and drawing, although not models of clearness, may suffice to enable a shrewd workman to construct the apparatus, but there is not any thing to guide us to a knowledge of what is claimed; it cannot be the use of water, and the lining of the cap, as these are not new, and this lining and upper trough may, according to the patentee, be omitted. We are apprehensive, however, that amending the specification would not remove the main difficulty, as it will not enable the machine to attain the proposed end, which we very much doubt its ability to do.

65. For an improvement in the manner of *raising and depressing the steam and exhaust valves of Steam Engines*; William Duff and Thomas Murphey, City of Baltimore, Maryland, February 17.

The object of this arrangement appears to be to operate upon the induction and eduction puppet valves by rods acting in a direct line. The claims are, "First, the arrangement of the valve-stem in the top-chest, in an inverted position, so as to be connected by means of the rod with the

stem of the valve of the lower chest, in a direct line. Secondly, the connection by means of the straps, as set forth, of the stuffing box of the female stem of the top chest, which box is also inverted, so as to be thus connected in a straight line with a stuffing box of the lower chest; and, finally, the adaptation of the two connected rocking shafts as described, to produce by means of the lifters and lugs, the alternate motion of the stems and straps."

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66. For an improved *Tire for Carriage Wheels*; James H. Rogers, Mount Morris, Livingston county, New York, February 17.

The tire is to be made hollow on the inside, so that its cross section shall present a curve, or two straight lines, forming an obtuse angle in the centre. "The use or application of the hollowed or grooved tire, for the purpose of carriage and other wheel building generally," constitutes the claim.

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67. For an improvement in the *Manufacture of Starch*; Walter and Thomas Leveredge, Dorchester, Norfolk county, Massachusetts, February 17.

"We claim a patent for manufacturing starch from rice, or for the application of rice as a substitute for other substances heretofore used in the manufacture of starch." Whether so broad a claim as this can be sustained is a very doubtful point. Rice is the principal food of a very large portion of the human race, and is, by millions, eaten to the exclusion of nearly every thing else, and that among a people who use starch largely in their manufactures; we have not at hand, or in memory, any direct information on the subject, but the probabilities are much against the absolute novelty of the manufacture.

The process followed by the patentees, but not claimed, is the following: fifty pounds chloride of lime are dissolved in one hundred gallons of water, and to the liquid when drawn off clear, eight pounds of sulphuric acid are added. Upon any quantity of rice as much of this liquor is to be poured as will just cover it, and it is to remain, with occasional stirring, for forty-eight hours. The liquid is then to be drawn off, and the rice ground, with water, to about the consistence of cream. To every one hundred gallons of this liquid, as much water is to be added, after which it is to be strained through a bolting cloth, to be allowed to settle for twenty-four hours, the clear liquid drawn off, and the starch dried.

We do not understand the chemistry of this proceeding, the first step of which is to make, and to destroy, a solution of chloride of lime.

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68. For a *Rotary Steam Engine*; Aaron Clark, Bangor, Penobscot county, Maine, February 17.

The construction of this engine is, in nearly all its parts, the same with that of many others of the rotary kind. A stationary and a revolving cylinder are employed, the latter being within the former, and furnished with two sliding valves capable of being forced into the body of it, by that portion of the outer cylinder which projects into the chamber for that purpose. These valves are widened on that edge which is within the inner cylinder, and upon these ends the steam is admitted, and is, by its pressure, to force them out. The claim is to "the mode in which the floats are forced out and into the revolving cylinder." The advantages pointed out

by the patentee are the same as those anticipated by the projectors of rotary engines generally, and, generally, terminating in disappointment.

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69. For a *Truss for Hernia*; William Adair, Pleasant Hill, Monroe county, Kentucky, February 17.

A straight strap, partly of leather, and partly of India rubber, is to pass round the body, and to have on it a wooden pad, covered with buckskin. Two narrow straps are to be used to keep it in its place, one passing round the thigh, and the other over the shoulder. This truss, we are told, "causes a pressure in the direction of the *abdominal canal*, [qu] by the inelastic hard wooden pad, thus effecting a permanent adhesion of the parts, &c." The claim is to "the before described truss." Such a truss is worthy of such a claim, as it is not distinguishable by any novel or good feature.

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70. For an improvement on the *Paper making machine*; Charles Forbes, administrator of Robert Rose, deceased, East Hartford, Hartford county, Connecticut, February 20.

An endless web of wire fourteen feet long, is to pass round two rollers so situated that the upper surface of the web shall form an inclined plane; eighteen or twenty small rollers are used to support this web on its under surface, and the lower end is to form a part of one end of a vat containing the paper stuff. The claim is to "the sustaining the web in a slanting position, so as to form the end, and in part, the bottom of the vat containing the stuff, or pulp, so that the pulp, by means of the water draining through the web, may be properly deposited on the web for the formation of paper."

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71. For an improvement in *Spectacle glasses*; Isaac Schnaitman, Northern Liberties, Philadelphia county, Pennsylvania, February 20.

Many persons have been in the habit of using segments of two glasses in each eye of spectacle frames, the segments being of different focii, so as to adapt them to distant or near objects. The patentee, instead of having divided glasses, grinds each glass so as to have two focal centres, and claims "the invention of grinding two separate and distinct focii in one piece of glass, adapted to various optical purposes, but principally to be used and applied as spectacle glasses."

We think this specification imperfect, inasmuch as it only informs us respecting the end attained, and leaves us in the dark as regards the means of arriving at it; the decisions say that a patent cannot be sustained for a result merely, but that it must be granted for the means of accomplishing it; and it will not be pretended that glasses, such as are here described, can be ground by the ordinary tools, or by the ordinary manipulation.

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72. For a *machine for Sawing Staves*; Aaron Bard and Simeon Heywood, Lunenburg, Worcester county, Massachusetts. First patented July 8th, 1834. Patent surrendered, and re-issued February 20.

We noticed this patent at page 93, Vol. xv, and mentioned the existence of a previous one for the same thing. The patent has been surrendered for the purpose of claiming those particular things in which the present patentees view their improvements as consisting; namely, "the manner of running the saw on friction wheels, lapped by each other; also the flanch,

or flanches, to keep the saw from running off its bearings; also the slide boxes for the axles of the friction wheels to run in and set them to the saw."

The saw is a complete hoop, which was included in the patent of Sumner King, noticed in Vol. xiii, page 121, and believed to be new; if this opinion was correct, it is presumed that the present patentees have acquired a right to it, without which their improvements would be of no value.

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73. For *Supplying Salt*; Peter Cooper, New York.

This has been registered in the Patent Office by mistake, the patent not having issued; and it is to be hoped that it never may, as the plan proposed is one which caps the climax of absurdity, being no other than to convert the water of our canals into brine, in order that salt may thereby find a cheap and easy conveyance.

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74. For an improvement in *Suction and Forcing Pumps*; Thomas C. Barton, Washington, Warren county, New Jersey, February 20.

This patent is not taken for any improvement in the principle of construction, but for certain modes of putting the parts together; these improvements are described as to be applied to a double cylinder pump, such as is generally employed in fire engines, and without the drawings an attempt to describe them would demand too much space and time for the subject matter.

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75. For *Hollow Cylindrical Flyers*, to be used in manufacturing yarn and thread; Samuel Ladd, Waltham, Middlesex county, Massachusetts, February 20.

The *hollow cylindrical flyers*, is merely a cylinder which surrounds the spindle, in the manner of the cap spinner, and we are unable, from the description, claim, or drawing, (or rather scratching,) to discover where the novelty, or invention, lies.

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76. For a *Saw Mill wherein hand saws are used for cutting off cross sections of wood*; Rufus Ricker, Dexter, Penobscot county, Maine, February 20.

The claim made is to "the described combination of levers to moving hand saws, (either one or more,) for sawing cross sections of timber or other substances." It does not appear, however, that the cross cutting is to be effected by *hand saws*, but by frame saws, moved by a combination of levers not specially meriting a description.

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77. For a *Wash for curing fever sores, King's evil, and most kinds of old sores*; Reuben Rood, Lisle, Broome county, New York, February 20.

"Take  $2\frac{1}{2}$  drams of blue vitriol, 4 drams of allum, 6 drams of loaf sugar, dissolve them in one pint of good vinegar; add three table spoonful of honey, and the mixture is fit for use. Keep the sore clean, and wash it twice a day with the above mixture until completely healed."

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78. For an improvement in the art of *Constructing Clocks*; William Pardee, Poughkeepsie, Dutchess county, New York. First patented May 22d, 1835. Patent surrendered, and re-issued February 25.

A notice of this instrument, as originally patented, is contained in Vol. xvi,

page 401. In the present patent the title is changed from an improvement in the *construction of time pieces*, to that of *the art of constructing clocks*; this is certainly no improvement in nomenclature as the affair is not a clock, there not being any striking movement whatever, but simply a watch, or time-piece movement. The following is the claim now made, or, which is the same thing, an exposition of what are deemed its characteristics.

"The principle of this improvement consists essentially in this, that it is a combination of a clock movement, in which the force is applied to the arbor that carries the minute hand, substantially as aforesaid, whence the force is communicated by wheels and pinions to the hour hand, and to the pallet wheel, where it is regulated by a pendulum of any convenient structure, with a clock case, or front, cast in any convenient form, in one piece, substantially as aforesaid. The force may be by weight and pulleys, or by spring."

That which appears to be considered an essential difference between this and other time pieces, namely, the application of the power to "the arbor that carries the minute hand," is not new, this having been done by Dr. Franklin in a time piece of his contriving. See article "Clock" in Rees' Cyclopædia, and most other works treating upon Horology.

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79. For a *Copper Still*, for the purpose of running alcohol from whiskey. First patented October 22d, 1834. Surrendered and re-issued February 20.

This patent is taken for an improvement upon a still patented in Europe, and known under the name of Saintmarc's still. The claims to improvement consist in "the particular manner of arranging the tubes and caps throughout the series of chambers, and the addition of the first, or goose neck, condenser, and its appurtenances, in the manner, and for the purposes set forth." The original still has been figured and described in the English Journals, and those interested in such matters may learn its construction by consulting them; the improvements would require a drawing for their illustration.

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80. For a *machine for Thrashing out Clover, and other small seeds*; James Cooper, Greene county, Ohio, February 20.

A cylinder is to be made of wood, armed with strips of iron, which are to rub the seeds against a concave placed under it; the concave is to consist of straw, broom-corn, or other fibrous substances placed endwise in a box, and compressed firmly together, the surface of which must, of course, be cut into such a form as will adapt it to the cylinder. The claim is to "the mode described of making the concave, or bed, of straw, broom-corn, split wood, bristles, split whale bone, or of other similar materials; also the mode of ironing the cylinder."

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81. For a *Winnowing Machine*; David Wilson, Johnson, Franklin county, Vermont, February 20.

This is denominated a *horizontal* winnowing machine, and it receives this name, we suppose, from the fan being made to revolve horizontally, to do which its shaft is acted on by bevel gear. This appears to be the only thing about it which stands a chance of being called new, and even this, it seems, was, correctly, accounted unworthy a claim, which extends only to "the arrangement and adaptation of the several parts of the before described horizontal winnowing machine."

82. For an *Injection Apparatus*; Joseph Ralph, New  
ruary 25.

A very formal description is given of this instrument, whic  
for administering injections in diseases of the urethra. It c  
India rubber bag, with an ivory female screw tied in the mout  
is to receive a stopper, to retain the water put into it, "wh  
intended to be converted into a lotion by the admixture therew  
tain powders prepared for this purpose." Other letters patent  
obtained for these *certain* powders, of which due notice will, no d  
given and properly displayed, in the public newspapers.

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83. For a *Truss for Hernia*; Francis Hollis Newman, Hunts  
Alabama, February 25.

In this truss the main novelty consists in making the pad of some flexib  
material which is impervious to air or water; which pad is to be kept di  
tended by one or other of those fluids. Where pressure is required from a  
less yielding material, a cap of metal is to be placed over the pad. The  
particular manner of confining the pad to the body is described, but in this  
there is not any thing worthy of notice, or differing materially from what  
has been frequently done. A claim is made to the application of pressure  
by means of liquids or gases, whether combined or not with the use of hard  
substances.

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84. For an improved *Lathe for turning Gun Stocks*; Abner Town,  
Woodbury, Caledonia county, Vermont, February 25.

We are informed that "the construction of the improved lathe or machine  
is such that both the guide and fly wheels remain stationary, while, in the  
operation of turning, the pattern and block pass them; whereas in the origi  
nal gun stock lathe, those wheels are movable and pass the pattern, and  
block, both of which remain stationary. Also, in the improved machine the  
pattern and block have each a separate mandrill turned by a wheel, which  
is not the case in the original lathe. Also the machinery attached to the  
carriage in the improvement is such as to produce a rocking motion instead  
of the swinging motion of the original lathe, &c."

We cannot attempt a verbal description of the differences pointed out in  
the foregoing abstract, which is to be considered as constituting the claim.

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85. For *Sawing by Lever Power*; Jeremiah Walker, Philips, Som  
erset county, Maine, February 25.

A pulley on a double crank shaft is connected by a strap or band to an  
other carrying a circular saw. The two cranks on the first shaft are in  
opposite directions, and each of them is connected by a pitman to a horizon  
tal lever under the frame work, so that these levers may work up and down  
like treadles: one of these levers is made long, and is to be worked up and  
down by hand, the other is short, and is loaded with a weight at its vibrat  
ing end; as the long lever is forced down the weight is raised, and as the  
long lever is raised, the other, with its weight, descends. This constitutes  
the whole affair, and he who does not pronounce the contrivance for con  
tinuing the power, greatly inferior to that of the ordinary fly wheel, knows  
but little of machinery.

86. For a *Cooking Stove*; Billy Titus, of Marshal, Oneida county, and Anson Titus, of Phelps, Ontario county, New York, February 25.

The claims made are to "the application of a tin or sheet iron, baker or cover, for the purpose of baking or cooking on the movable hearth, in the manner specified; and the application of a box stove of very small size, and in its simplest and cheapest shape, to cooking, as described." The stove and its fixtures appear to us so much like many others, that we cannot venture to tell what is meant by the foregoing claims.

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87. For a *Vibrating Pump*; Sampson Davis, Derby, Orleans county, Vermont, February 25.

The patentee says, "what I claim as new, is a new improvement of principle in the method of raising and conveying water, by means of the *vibrating pump*. I claim no more." This new application of principles consists of a small overshot wheel, supplied with water in the usual way, and having a crank upon one end of its shaft, which is to work the piston of a small force pump. The cylinder of the pump is made to vibrate, like that of the vibrating steam engine, and the water is to be delivered through a flexible hose, admitting thereby of a free vibration.

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88. For a *Spark Consumer*; Francis Milo, Albany, New York, February 25.

The specification and drawing of this apparatus do not render its construction clear, and the claim to "the before described apparatus" does not lend any aid in "distinguishing the same from all other things before used or known."

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89. For a *Smut Machine*; Abraham Mudge, Canajohaire, Montgomery county, New York, February 25.

"The principle which I claim to have applied to the purpose of cleaning grain from smut and other impure substances, by means of the machine above described, and which application I claim to have invented, is that of throwing the grain by means of wings, or flanches, attached to a circular plate as above described, against some hard substance with sufficient force to break smut balls, &c."

This apparatus appears to be very well calculated to effect the proposed object, and to blow off the dust from the smut and other sources, but the form of the claim is objectionable, as the same principle has been before applied for attaining the same end, and it is the particular method of applying the principle, alone, which is the proper subject for a claim.

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90. For an improvement in the *Saw Mill*; David Worthington, Peru, Berkshire county, Massachusetts, February 25.

The saw used is to be furnished with teeth on each of its edges, and is to cut the stuff as the carriage travels in either direction. There are to be two rag wheels with teeth in opposite directions, and two feed hands, one for each wheel; the double toothed saw is not new, and is not claimed as such, the claim being confined to the particular arrangement adopted for moving the rag wheels; a thing in which there is no difficulty whatever, every machinist knowing methods of accomplishing this object, which no patent can prevent him from employing.

91. For a *Bee House*; Ebenezer Beard, New Sharon, Kennebec county, Maine, February 25.

The claim made is to "the manner of constructing and arranging the hives and boxes within the house, and the manner in which the bees communicate therewith." We have no doubt that the arrangement described, is convenient and beneficial, but we do not think that it is sufficiently distinguished, in the description, from other similar contrivances, to admit of a claim so general.

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92. For a *machine for Washing and Pressing Clothes*; Caleb Angevine, City of New York, February 25.

The claim is to "the circular wash cask; the manner and mode of applying the steam; the dog or other animal power to the cylinder; together with the formation of the horizontal press, and also the perpendicular lever press, as described in the specification."

We cannot say much for the novelty of the individual things claimed, as will be evident from a brief description. There is a boiler with a furnace under it, and a steam pipe leading from it into a horizontal cylinder, within which the clothes are to be placed, and agitated by dashers, made to revolve by a winch, in the ordinary way. The pressing is effected by placing the clothes within a cylinder, and forcing them together by means of a piston, or follower; the application of dog power, is, we apprehend, a mere embellishment, giving some life to the affair.

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93. For an improvement in the *Cotton Gin*; Henry Clark, Montville, New London county, Connecticut, February 25.

This improvement consists in making the iron ribs between which the saws pass, in two thicknesses, the front being of steel, and attached to the iron by screws. The claim is to "the making the ribs in two parts, so that they can be easily detached and repaired."

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94. For a *Floom Gate*; Harvey Frink, Hanover, Chautauque county, New York, February 25.

We have read the description of the floom gate which forms the subject of this patent, but the drawing has been mislaid; the former without the latter, would not be clear, and we shall not, at present, therefore, venture any opinion respecting the affair.

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95. For an *Instrument for determining the variation of the needle, the true meridian, and the apparent time*; William A. Burt, Mount Vernon, Macomb county, Michigan, February 25.

The graduated arcs of circles, and the other appendages used, must be placed upon a circumferentor, or other analagous instrument, furnished with a level. The particular construction of the parts might be made known by verbal description, did we think proper to give the necessary space and time, but these we cannot now afford. There is nothing in the principle which would be new to the scientific observer; the only novelty being the particular arrangement of its parts.

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96. For *Saw Mill Dogs*; Martin Rich, Caroline, Tompkins county, New York. First patented, March 6th, 1834. Surrendered and re-issued February 25.

This patent was originally noticed under its proper date, since which 'it has been discovered that the claim made was too broad, and it is now limited to what appears to be new in the invention.

97. For *Saw Mill Dogs*; Phineas Bennet, Hector, Tompkins county, New York. First patented December 2d, 1834. Patent surrendered and re-issued February 25.

The observations upon the preceding patent apply to this also; they are now both owned by the same individual, and parts of the two are combined in practice. The owner of them, by assignment, is Chas. E. Handy, Esq., Ithaca, New York.

98. For an improvement in *Fire Arms*; Samuel Colt, Hartford, Hartford county, Connecticut, February 25.

This appears to be a very ingenious application of the revolving breech, to pistols, and other fire arms. The description is of considerable length, and refers throughout to numerous figures which are necessary to the understanding of the particular construction and arrangement of the parts. The claim, alone, would not afford any correct ideas respecting them.

99. For an improvement in the *Boot Tree*; Mathew Mathews, Wayne county, Ohio, February 25.

The members of the craft if they feel an interest in the peculiarities of this last of the boot trees, must apply at the patent office for a copy of the specification and drawing, the latter being necessary to the understanding of the former.

100. For a *House Warmer*; O. Kindrick, and W. Elwell, Gardiner, Maine, February 25.

A hollow box of iron is placed across the back of the fire place, with a tube from one end of it leading into a cellar, or other place, for a supply of cold air, the other end being furnished with a tube to conduct the heated air into the room; this latter tube is to pass to some distance up the chimney, where it is to be elbowed, so as to admit the heated air into the room; and the patentees say, "what we specifically claim as our improvement, and for which we ask an exclusive right, is the making of, and applying a box, cistern, or cockle, as above described, to a common fire place, fire frame, or stove, for the purpose of heating, or warming, rooms."

This plan is equally old, and inefficient. Would it not be well to add a dog wheel, or some other motive power, to force air through the tube by means of a blowing apparatus?

## Progress of Physical Science.

### *Formation of Æther.* By M. MITSCHERLICH.

The decomposition of alcohol into æther and water is not interesting merely by the production of æther, but is especially so as an example of a particular kind of decomposition, which cannot be so well followed with any other substance, and which is manifested in the formation of some important products, for example, in that of alcohol itself. M. Mitscherlich has endeavored to elucidate the phænomena of this decomposition by the following

experiments: Take a mixture of 100 parts of sulphuric acid, 20 of water, and 50 of anhydrous alcohol, and heat it gradually until its boiling-point becomes  $284^{\circ}$  Fahrenheit. Alcohol is then allowed to fall gradually into the vessel which contains the mixture, and the current is to be so regulated that the heat of the mixture remains constantly at  $284^{\circ}$ . If, for example, the operation be conducted with a mixture of six ounces of sulphuric acid, one ounce and one-fifth of water, and three of alcohol, and if the density of each two ounces of product as it is obtained be taken, it will be observed that this density passes gradually from 0.780 to 0.788 and 0.798, and afterwards remains constantly at the last mentioned density, which is exactly that of the alcohol employed.

If the operation be properly conducted, an unlimited quantity of alcohol may be converted into æther, provided that the sulphuric acid does not change. The distilled liquor is formed of two distinct fluids; the upper one is æther, containing a little water and alcohol; the lower one is water with a little alcohol and æther. Its weight is nearly equal to that of the alcohol employed, and it is composed of

Æther,	. . . . .	65
Alcohol,	. . . . .	18
Water,	. . . . .	17—100

If into six ounces of concentrated sulphuric acid six ounces of pure alcohol are suffered to flow gradually, a product of constant density is not obtained until the sulphuric acid has taken its proportion of water. Take, on the contrary, three ounces of sulphuric acid and two ounces of water, and let alcohol be added, drop by drop; the first two ounces distilled are merely spirit of wine, of specific gravity 0.926, containing scarcely a trace of æther. The density decreases until the quantity of water of the sulphuric acid is reduced to its proportion, and the product of the distillation has acquired the density of the alcohol. If concentrated sulphuric acid be added to anhydrous alcohol in excess, pure alcohol distils at first; but when the temperature reaches nearly  $260^{\circ}$  the first traces of æther begin to appear; the production of æther is at its maximum between  $284^{\circ}$  and  $302^{\circ}$ .

It results from the preceding observations, that alcohol when in contact with sulphuric acid, is converted into æther and water at a temperature of about  $284^{\circ}$ . A great number of analogous decompositions and combinations are known which may be attributed entirely to the influence of the contact of bodies. The most remarkable example of this kind is that of the conversion of oxygenated water into water and oxygen, by the slightest trace of the peroxide of manganese and some other substances. The decomposition of sugar into alcohol and carbonic acid, the oxydizement of alcohol when it is changed into vinegar, are phænomena of the same kind; and so also is the conversion of starch into sugar by means of sulphuric acid. M. Mitscherlich, observing that in the preparation of carburetted hydrogen by means of sulphuric acid and alcohol, water is formed at the same time, attributes this decomposition of alcohol to the influence of mere contact, and not to the affinity of sulphuric acid for water.

*Journal de Pharmacie, Juin, 1835, & Lond. and Edin. Philos. Jour.*

“Report of Magnetic experiments tried on board an Iron Steam-Vessel, by order of the Right Hon. the Lords Commissioners of the Admiralty.” By Edward J. Johnson, Esq., Commander, R. N., accompanied by plans of the vessel, and tables showing the horizontal deflection of the Magnetic needle at different positions on board, together with the dip and magnetic

intensity observed at those positions, and compared with that obtained on shore with the same instruments.

This report commences with a description of the iron steam-vessel, the "Garryowen," belonging to the city of Dublin Steam Packet Company, and built by the Messrs. Laird, of Liverpool. She is constructed of malleable iron, is 281 tons burthen, and draws only  $5\frac{1}{4}$  feet water, although the weight of iron in the hull, machinery, &c. is 180 tons.

The experiments having been interrupted by a continuance of wet and stormy weather, the author proceeds to draw the following general practical conclusions, deduced from the series of observations already made, and points out the further experiments which he considers necessary to be tried.

1st. The ordinary place for a steering-compass on board ship is not a proper position for it in an iron steam-vessel.

2nd. The binnacle-compass in its usual place on board the Garryowen is too much in error to be depended upon.

3rd. In selecting a proper position for a steering-compass on board iron steam vessels, attention should be paid to its being placed, as far as is practicable, not only above the general mass of iron, but also above any smaller portions of iron that may be in its vicinity; or such portions of iron should be removed altogether.

4th. The steering-compass should never be placed on a level with the ends either of horizontal or perpendicular bars of iron.

5th. The extreme ends of an iron vessel are unfavorable positions, in consequence of the magnetic influences exerted in those situations. The centre of the vessel is also very objectionable, owing to the connecting rods, shafts, and other parts of the machinery belonging to the steam-engine and wheels, which are in continual motion; independently of the influence exerted by the great iron tunnel in this part of the ship.

6th. No favorable results were obtained by placing the compass either below the deck, or on a stage over the stern.

7th. It was found that at a position of  $20\frac{1}{2}$  feet above the quarter-deck, and at another  $13\frac{1}{4}$  feet above the level, and about one-seventh the length of the vessel from the stern, the deflections of the horizontal needle were less than those which have been observed in some of His Majesty's ships.

The author proceeds to point out various methods of determining, by means of a more extended inquiry, whether the position above indicated, or one nearer to the deck, is that at which the steering-compass would be most advantageously placed.

The concluding section contains an account of some observations made by the author on the effects of local attraction on board different steam-boats, from which it appears that the influence of this cause of deviation is more considerable than has been generally imagined; and he points out several precautions which should be observed in placing compasses on board such vessels.

*Proceedings Roy. Soc. Lond. and Edin. Philos. Mag.*

*Hydraulic Lime.* M. Vicat communicated a paper to the Royal Academy of Sciences at Paris, on the sole efficacy of magnesia in rendering certain limestones hydraulic. This paper has for its object the correction of an opinion given by M. Berthier in the *Journal des Mines* of 1832, that magnesia alone has no more efficacy than alumina to render lime hydraulic; from which it would follow that silex was the only essential principle in all cases.

M. Vicat was for a long time of the same opinion, which he now declares i incorrect; and says that magnesia alone, when in sufficient quantity, will

render pure lime hydraulic. He does not explain the degree of energy of these new species of lime, but only affirms that they will solidify from the 6th to the 8th day, and continue to harden in the same manner as ordinary hydraulic lime.

Until his experiments are further advanced, he states that the proportions of magnesia taken and weighed after calcination, should be from 30 to 40 for every 40 of pure anhydrous lime. The native limestones examined and cited by M. Berthier contained only from 20 to 26 of magnesia for every 78 to 60 of lime: it is probable that this want of proper proportions was the cause of his negative results. M. Vicat, in conclusion, points out the importance of these observations,—hydraulic lime never having been found in the calcareous formation below the lias, is because the dolomites have never been examined, but it is now probable it may be found in this lower formation. *L'Institut*, No. 153., and *Lond. and Ed. Phil. Mag.*

*Liquefaction of Sulphuretted Hydrogen.* Mr. Kemp discovered a very beautiful process for the liquefaction of sulphuretted hydrogen: he found that if dry persulphuretted hydrogen be introduced into a liquefying-tube, it slowly resolves itself into liquid protosulphuretted hydrogen, whilst sulphur in crystals is deposited. If previously there has been introduced into the end of the tube iodine in a dry state, then the protosulphuretted hydrogen, when it comes over upon it, dissolves it rapidly, and a dark yellowish brown coloured liquid results. If now to this there be added the least possible proportion of water (which is accomplished by a peculiar bend in the tube), instant reaction takes place, sulphur is deposited, and hydriodic acid in a most condensed and liquid state results. It is only necessary that a trace of water be present to commence the decomposition of the former brown compound, which I suppose to be the hydrosulphuret of iodine; for when this once commences, it goes on to any extent, and the liquid hydriodic acid formed may be called almost anhydrous. It boils by the heat of the hand like other condensed gases; it is of a yellowish colour, and resembles somewhat liquefied chlorine. *Lond. and Edin. Philos. Mag.*

*Experimental Researches in the laws of the motion of Floating Bodies.* By J. S. RUSSELL. It was the object of these inquiries to assist in bringing to perfection the theory of Hydrodynamics, and ascertain the causes of certain *anomalous facts* in the resistance of fluids, so as to reduce them under the dominion of known laws.

The resistance of fluids to the motion of floating vessels is found in practice to differ widely from theory, being, in certain cases, double or triple of what theory gives, and in other and higher velocities, much less. These deviations have now been ascertained to follow two simple and very beautiful laws: 1st. A law giving a certain *emersion* of the body from the fluid as a function of the velocity. 2nd. A law giving the resistance of a fluid as a function of the velocity and magnitude of a wave propagated through the fluid, according to the law of Lagrange. These two laws comprehend the anomalous facts, and lead to the following results:

1. That the resistance of a fluid to the motion of a floating body will rapidly increase as the velocity of the body rises towards the velocity of the wave, and will become greatest when they approach nearest to equality.

2. That when the velocity of the body is rendered greater than that due to the *wave*, the motion to the body is greatly facilitated: it remains poised on the summit of the wave in a position which may be one of stable equilibrium; and this effect is such that at a velocity of nine miles an hour the resistance is less than at a velocity of six miles behind the wave.

3. The velocity of the wave is independent of the *breadth* of the fluid and varies with the square root of the *depth*.

4. It is established that there is in every navigable stream a certain velocity at which it will be more easy to *ascend* the river against the current than to *descend* with the current. Thus, if the current flow at the rate of one mile an hour in a stream four feet deep, it will be easier to *ascend* with a velocity of eight miles an hour on the wave, than to *descend* with the same velocity behind the wave.

5. That vessels may be propelled on the summit of waves at the rate of between 20 and 30 miles an hour. Trans. Brit. Assoc. & Lond. and Edin. Philos. Mag.

*Communication of Vibrations through soil.* By Capt. DENHAM. Capt. Denham ascertained that the vibrating effects of a passing laden rail road train in the open air extended laterally on the same level 1110 feet, (the substratum of the positions being the same,) whilst the vibration was quite exhausted at 100 feet when tested vertically from a tunnel.

The tunnel was through a stratum of sandstone rock: the rails laid in the open air on a substratum of 12 feet of marsh over sandstone rock. The method of testing was by mercury reflecting objects to a sextant. The experiments were made in the neighborhood of Liverpool.

Trans. Brit. Assoc., Lond. and Ed. Philos. Mag.

### Progress of Practical and Theoretical Mechanics and Chemistry.

*Cutting Veneers.* Veneers used to be cut by the hand-saw; at present, the circular saw is, I believe, universally employed in England for this purpose, with the advantage not only of cheapness and expedition, but of a smaller waste of wood in saw dust, and of greater accuracy and precision in the thickness of the veneer—a quality essentially requisite to produce good work in the finished article.

In a large veneer-mill which I had an opportunity, through the kindness of one of our members, of visiting, there are five circular saws. Each consists of a strong, stiff, circular frame-work, of the shape of a plano-convex lens, or rather a low hollow cone, tapering gradually to the edge, from which projects a ring of soft steel a few inches broad, pierced with many holes. The saw is a plate, or rather a flat ring, of well-tempered steel, about twelve inches broad, pierced with as many holes as the former ring, and firmly secured to it by means of screws: a band over the axis of the saw communicates motion to it, by connecting it with the first mover, which is a steam engine. The wood to be cut is laid on the cross-bars of a frame, which are previously covered with glue, and remains in a horizontal position, loaded with heavy weights, till the glue has become dry. The frame, with the log, or *flitch*, as it is technically called, adhering to it, is then fixed sideways in a carriage which traverses backwards and forwards, the frame itself being likewise capable of motion at right angles to the run of the carriage, in order to project the log sufficiently to bring it within the action of the saw. The quantity of the latter motion is regulated by a screw, one turn of which throws forward the frame, and, consequently, the log, about  $\frac{1}{30}$  of an inch. The saw being put in motion, the workman first turns the regulating screw more or less, according to the required thickness of the veneer; he then, by pulling a lever, throws the apparatus into gear, which gives motion to the carriage, and takes his seat by the inner, or con-

vex, side of the saw. As soon as the log comes up to the saw, he directs the head of the veneer into a curved frame, which it readily enters, on account of its flexibility, being so very thin, and then employs himself in holding in each hand a chip of wood obliquely against the teeth of the screw, in order to clear them of the particles of saw dust which otherwise would more or less clog up. In a minute or two the log has passed the saw, the motion of the carriage is reversed, and it is brought back to the point from which it first started. Being then thrown out of gear, the regulating screw is again turned, to project the log as much as the intended thickness of the next veneer; and then all those motions are repeated which I have already described. The usual thickness of a veneer is about  $\frac{1}{12}$  of an inch; but some kinds of wood may be cut as thin as about  $\frac{1}{16}$  of an inch. About half the wood is converted into saw dust.

Of the fine saws employed at these mills, the largest is eighteen feet in diameter, and makes thirty revolutions in a minute. Three are each ten feet in diameter, with a speed of about sixty revolutions in a minute; the small saw is six feet in diameter, with a speed of eighty revolutions in a minute, which is sometimes increased to one hundred, or even one hundred and twenty revolutions. The teeth of the saws are nearly a quarter of an inch deep. A saw lasts about a year; for the first six months it is employed in coarse work, and afterwards, till worn out, in fine work.

The veneer is necessarily split, for an inch or two at its head, in getting it on the curved frame; and as it is likewise liable to split in drying, a thin strip of linen is glued along the two cross edges of each veneer, which prevents this accident: the holes, at least those of an inch or more across, are also covered in the same manner.

The general method of laying down veneers is very simple, although to do this well and correctly, requires, as every thing else does, practice, attention, and patience. The under side of the veneer, if previously smooth, must be scored by means of a toothing-plane; but if cut by a circular saw, it generally acquires a sufficient tooth by that operation. The surface to be veneered is covered over with strong glue, and before it chills or gelatinizes, the veneer, previously prepared and cut to the shape required, is laid down upon it, care being taken in doing so, to enclose as little air as possible. When it has been pressed down to its proper bearing in every part, the compound piece is enclosed between two hot boards, secured at the edges by thumb screws, or, which is still better, is put into a press between two hot plates, where it remains till perfectly dry.

The next process is to give a smooth surface to the veneer, which is effected by first filling up any holes by plugs of the same kind of wood cut to fit them, or by making a paste of fine saw dust and glue, and pressing it into the holes by hand, and then by the successive use of small planes, scrapers, files, glass-paper, Dutch rushes, and fish skin. Lastly, a varnish is added, which has the effect of bringing up the colour and lustre of the wood, and protecting it from the action of the air. If the colour of the wood is itself unexceptionable, the varnish should be as colourless as possible; but if a little mellowness or warmth is required, a varnish coloured accordingly must be applied. The so called, French varnish, has within the last few years almost entirely superseded the oil varnishes, as being more quickly applied, possessing more lustre and hardness, being less liable to be injured by any common liquid spilled upon it, and not requiring to be renewed or refreshed except at long intervals. It is made by dissolving lac in spirits of wine, and then shaking it up with olive-oil to the consistence

of an emulsion, in which state it must be used. It is fixed on the surface of the wood by means of a linen rubber, applied with a circular or spiral motion. Varley in Trans. Lond. Society Arts.

*Lighting and Ventilation.* Questions proposed by the Committee of the Athenæum to Mr. Faraday, on Lighting and Ventilation, with the answers. Originally printed February 14th, 1831.

[We re-print the present article, by permission, from a document which has been circulated among the members of the Athenæum.]

Q. What is the ratio of light of an oil and gas burner?

A. In an experiment made at the Athenæum, with an excellent Argand oil lamp, regulated by Mr. Hancock, and compared with a 15-hole gas burner, the light of the gas was to that of the oil as 21 to 13.

Q. What is the ratio of heat?

A. In experiments made to determine the heat evolved for *equal quantity of light* from oil and gas burning brightly from Argand burners, the heat from the oil being 2, that from the gas was nearly 3.

Q. Is either sulphurous or sulphuric acid formed by the combustion of coal gas in the ordinary way?

A. A little sulphurous or sulphuric acid is generally formed from the combustion of coal gas. If well purified gas be used, this product is rarely sensible: it is less sensible as sulphuric than as sulphurous acid. Upon closely questioning persons who have declared that they smelt sulphur from gas, I have usually found they meant something else—generally the oppressive heat, or the dry sensation, or the smell of a little gas unburnt, none of which have any thing to do with the sulphur-product from gas.

Q. From a gas light, properly regulated, is gas respired?

A. I do not believe that any gas escapes unburnt from a gas light well regulated. It is far more likely that oil vapour should escape unconsumed from an oil burner, than gas from a gas burner.

Q. Will an oil or gas light soonest soil the ceiling of a room?

A. Neither oil nor gas ought to soil, or will soil, the ceiling of a room, if well regulated. Either will do so when badly regulated. I think of the two, oil is most likely to do so; because of the changes which take place in the wick, in the temperature of the oil, &c., during burning, and which do not occur with a gas lamp properly regulated by a governor.

Q. What effect will the heat evolved have on the temperature of a room?

A. This effect depends upon so many circumstances, as the size and tightness of the room, the proportion of light, &c. &c., that it can only be deduced from a series of observations.

Q. What are the comparative effects of oil and gas lights on the quality of the air, light for light?

A. It is exceedingly difficult to ascertain, and if ascertained, to describe correctly the effects of lights on air so as to convey a just opinion of their influence; thus, with regard to their greatest effect, which is the power of heating, it is of advantage and desirable up to a certain point, and above that point is unpleasant and disagreeable: but that point depends upon many other things as well as the lights, and, what is still more important, differs for different persons, so that it becomes in that respect impossible to please all. Gas light will heat air faster than oil light; it therefore at first does good quicker, and afterwards does harm quicker, than oil. As to the proportionate deterioration of air by the oxygen abstracted, I think it probable that gas would, *light for light*, have the greatest effect; but I do not believe that effect would be sensible in either case. As to the deterioration of air

by the sulphurous acid and unburnt gas thrown into the room, I think little of it in the present case. I think that to be rather a popular error, caused by persons ascribing effects which they feel but cannot discriminate, to the first single cause which occurs to them, thinking of quality only and forgetting quantity.

Q. What are the comparative qualities of the light from oil and gas?

A. When the oil was burning in its best manner, still it gave a much yellower flame than the gas; the whiteness of the gas flame is a necessary consequence of its higher temperature.

Q. Taking all the circumstances into consideration, what, in your opinion, is the cause of the oppressive feeling complained of in certain rooms in the Athenæum?

A. In my opinion the principal cause of complaint is of the following nature: A house has been built, and every endeavor made to render floors, ceilings, windows, walls, and doors, tight and close; the rooms in it are well warmed during the day, and, having been brought to such a temperature and state that the first person who enters is fully satisfied; from fifty to two hundred persons are introduced, evolving both heat and effluvia; a number of powerful burners are put into and continue in action; and when the injurious agency of these causes has continued for one, two, or three hours, complaints are made that the heat is oppressive, or the odour unpleasant. Things are arranged so as to produce a perfect effect under one set of circumstances, and then, changing the circumstances, the effect is expected to remain the same, though it must of necessity be different. The large room and the library are made quite warm enough by daylight, when there are only a few persons there: then they are lighted, many persons enter, and they must of course very soon expect an oppressive sensation. I have no hesitation in believing that the cause of these complaints might be removed by extending and adjusting the system of ventilation in those rooms.

Q. Why has oil been displaced by gas in the public rooms of the Royal Institution?

A. Oil has been displaced by oil gas, in the first place, because of the economy of the latter; then because of its superior cleanliness, and its facile management. Much harm was done to our seats in the lecture-room during the use of oil lamps. We still burn oil in table-lamps in our library, on other evenings than the Fridays, because we require less light on those occasions.

*Athenæum, London, 26th April, 1836.*

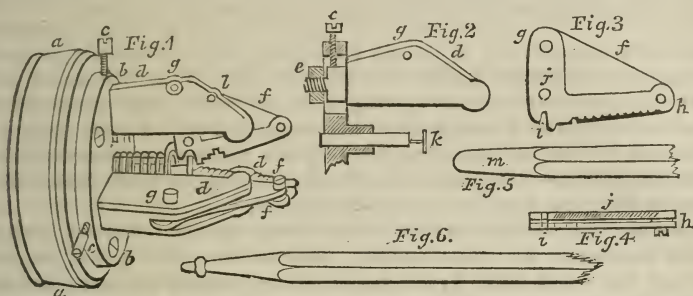
Rep. Pat. Invent.

*Franklin's machine for making Tips for Umbrellas.* The ribs or stretchers of umbrellas are terminated below in balls or some other ornament which are *tips*. These tips are sometimes of bone or of metal, and sometimes the ribs are *self-tipped*; that is, the tip is made by rounding the end of the whalebone itself into the required figure. Considerable difficulty has been experienced in making these tips with sufficient precision, as they must of course be made in some cheap and expeditious manner. The usual method was by rough-filing them into shape, and then giving the requisite degree of smoothness by means of glass-paper. Mr. Franklin, perceiving the tediousness of this mode, and yet knowing that whalebone, from its fibrous and elastic structure, requires to be brought into shape rather by filing and scraping than turning, which would be liable to tear up the fibres, has devised a tool possessing the properties of the file and scraper combined, and at the same time working with great speed.

Mr. Franklin obviates the necessity of fixing the whalebone in the chuck,

by holding it in a hand-vice and presenting it between three compound cutters that project from the face of a chuck, and revolve with the full speed of the lathe, by which the determined form is almost instantaneously given to it.

In fig. 1 *a a* is the chuck which screws on to the nose of a mandril: it has a seat turned in it to receive the circular plate *b b*, and a cavity deep enough for screw-nuts at the back of the plate. In this plate are three radial openings with adjusting-screws *c c* at their ends, in which are fitted the three forked frames *d d d*, which are fixed by screw-nuts, one of which



*e* is shown in fig. 2. These frames hold the compound cutters *f f f* by the screws at *g g*, on which they turn as joints. Fig. 3, shows a side view of one pair of cutters, and fig. 4, a front view of their cutting edges. They are made of thin steel: the triangular plate *f* is filed along the edge *h i* to the exact form of the tip, and is set to a sharp cutting edge; on this is placed the second plate *j*, having collets interposed to keep them a little asunder, as shown in fig. 4. This plate is at first formed so as to correspond perfectly with the under one; it is then filed into a waved edge, almost as if making a saw: these small notches are inclined, as shown in fig. 4, in order to make their cutting edges meet the whalebone. The three pairs of these cutters are made exactly alike, and the holes *g*, by which they are jointed in the frames *d*, are also quite alike. The cutters so prepared are put into their frames *d*, and these are slightly bound in their places by the nuts *e*; they are then placed exactly at equal distances from the centre by the adjusting-screws *c c*, and then the nuts *e* are bound quite fast to fix them. It is requisite for these cutters of themselves to keep open enough to receive the whalebone; and it is also requisite for them to close exactly alike on the whalebone when the workman presses it in. To press them outwards or open, a spiral spring is placed on a neck projecting from the centre of the plate *b b*; and to make them open or close equally together, a poppet *k* slides in the central neck, as shown in fig. 2: this has a thin circular head *k*, and the cutters have exactly similar notches as at *i*, fig. 3, into which this head enters, and thereby causes them to move simultaneously. The cutters would fly outwards, poppet and all, if there were not a stop; but, as they can only move together, a stop to one cutter is enough—the screw *l*, fig. 1, is that stop: the back of the cutter *f* comes against it when they are all open enough. *m*, fig. 5, represents the end of a whalebone previously rounded, ready to be thrust in between the cutters described, whilst they are in rapid rotation: the waved cutters come first in contact with the whalebone, and cut through the fibres without tearing them up; the clear

cutters follow, and scrape off the ridges as fast as they are made by the waved cutters. This operation, being thus divided between two cutters, prevents the breaking up of the fibre. Fig. 6, shows the form given to the tip by these cutters. The cutters are never stopped to change the whalebone, but are kept constantly revolving, and the tips are formed almost as fast as the workman can press them in and take them out. Experience soon teaches him to give the pressure at which the cutters will act best on the material, which comes from this tool smooth enough to be varnished, or to be polished with oil and charcoal dust on leather. For this purpose the whalebone is turned quickly round with one hand, being at the same time supported on the thigh, whilst the other holds the leather round the tip to polish it.

Trans. Lond. Soc. Arts.

*Howlett's Crayons for Drawing on Glass.* Mr. Howlett's perspective tracing-glass consists of a plate of clear glass fixed in a frame, and set upright on a tripod stand, so as to bring it on a level with the eye of the artist. From the top of the tripod projects horizontally a light frame, with a hole at the end, for the purpose of supporting in a vertical position a pin, at the top of which is a small perforation, through which the artist looks while he traces on the glass the objects seen through it.

So far the instrument does not differ in any material respect from those usually employed for this purpose. But as the glass is not capable of receiving the traces made by the pencil, it is necessary to cover the surface of the glass with some substance, at the same time as transparent as possible, and capable of being marked by a pencil. These conditions, however, have not hitherto been found to be reconcilable: the most transparent paper that can be made is not capable of allowing distant objects to be seen through it with sufficient distinctness, and glass itself, though unexceptionable with regard to transparency, will not retain traces from a black lead pencil, or from any other of the materials usually employed in sketching.

The way in which Mr. Howlett has solved this problem, is by the invention of crayons capable of bearing a fine point, and of leaving traces on the surface of glass. In the use, therefore, of this instrument, the objects are delineated with the crayon on the surface of the glass, and afterwards a piece of paper is laid over the drawing, and is secured by its four corners to prevent it from slipping; the glass with the attached paper is then held up to the light, and the objects already drawn on the glass are traced on the paper with a common pencil. If the paper, instead of being laid on the drawing, is placed on the opposite surface of the glass, the copy will be made in a reversed position, and is thus immediately adapted to the use of the engraver: or the tracing on the glass may be transferred to the paper, by laying the paper over the tracing, and rubbing them together with an ivory handled knife.

If the tracing-paper employed is thick or opaque, so that the lines on the glass are only seen indistinctly through it, a great degree of blackness may be given to them, by dusting the surface of the glass over with dry lamp-black, and then rubbing it off with a soft camel-hair brush, very lightly applied; the traces made by the crayon being somewhat adhesive, the lamp-black will be fixed on them by the action of the brush, while it is swept off from the rest of the surface.

The crayons are made of three degrees of hardness, to suit any climate, and are not acted on by water, either fresh or salt. Asphaltum and yellow bees-wax, in equal proportions, are melted together, and then lamp-black, just sufficient to give it colour, stirred in; the mixture is then cast into

sticks, and forms a crayon suitable for a temperate degree of heat; but, for very hot weather, the hardest kind of heelball, lowered with a little tallow, answers admirably.

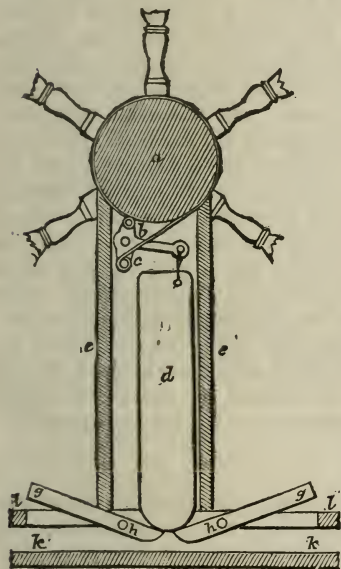
The glass plate, previous to drawing it, should be rubbed well with a leather, in order to free it from moisture or dirt, and the artist, while making the drawing, should wear a finger-stall.

It is sometimes difficult to bring the crayon to a fine point with a common penknife; for if the edge of this latter is set to the shape of a very fine wedge, it will slip through the crayon, as, on the other hand, a blunt wedge will break off the point before it has been cut sufficiently fine; but if the knife is set chisel-shaped, the oblique surface being applied next to the crayon, shavings of extreme tenuity may be taken off, and a very fine point will be the result.

Trans. Soc. Arts, Lond.

*Pearce's Stopping for a Steering-Wheel.* The pressure of the sea on the rudder is sometimes so strong, as to overpower the man or men at the steering-wheel; the consequence is, that the men are knocked down, and often seriously hurt, and the safety of the ship itself may be endangered by the rudder suddenly flying round. Mr. Pearce has done for the steering-wheel what has long ago been done for the crane and other similar machines; that is, he has attached a brake to it, capable, by its friction, of so far controlling the pressure of the rudder, as to enable the helmsman to retain the command of it.

The annexed figure presents a section immediately behind the wheel, and before its post, the spectator looking a head. The axis of the wheel *a* is nearly surrounded by a copper band, the extremities of which, *b* and *c*, are attached to the short arms of a T-shaped lever turning on a centre between *b* and *c*, and from the longer arm of which is suspended the leaden weight *d*. The end *c* of the copper band is split, and its halves pass on each side of the T-shaped lever. The whole of this apparatus is contained in a case formed in front of the post, the sides of the case *e e* being shown in section. It will be seen that the effect of the weight *d*, acting through the instrumentality of the T-shaped lever, is to tighten the copper band round the axis of the wheel, and thus, if not to supersede, at least very much to relieve, the labour of the steersman in holding the wheel during rough weather. When any alteration in the ship's course is required, the wheel may be set free by



pressing the foot on either of the levers *g g*, which turn on the centres *h h*, raise the weight *d*, and thus relieve its pressure on the copper band. The levers *g g*, may, when required, be kept permanently down, in which case they form a part of the small floor or platform *l l*, raised a few inches above the surface of the deck *k k*. Ibid.

*Higgins Oblique Candlestick.* In the annexed figure *a a* is the tube which contains the candle, resting on the spiral spring: it is about fourteen inches long, rather more than an inch in diameter, and is inclined about thirty degrees from a vertical line. The cap or nozzle *a b* slips on with a bayonet joint, and has a hole at the end about five-eighths of an inch in diameter, through which the wick protrudes. A small lip *c* projects from the nozzle, to catch any trifling overflow of tallow which may possibly happen when the candle is first lighted. The base of the candlestick *d*, and the curved support *e* to which the extinguisher is attached, do not require description. It is obvious that the spiral spring must be of such a length as to keep the candle close up to the cap *b* till it is entirely consumed.



From several experiments it appears that a candle placed in this stick is burned more perfectly, and with less waste and guttering, the more it is blown about by the wind, provided the draft is not so violent as to extinguish it. *Ibid.*

*Indian Sword-Blades.* The thanks of the Society were voted to Capt. BAGNOLD, R. N., of Blackheath Villa, Saxmundham, for the following account of the manufacture and tempering of Sword Blades in the province of Cutch, from information communicated to him by his brother, Lieut. Colonel Bagnold, late President of the Regency in Cutch. These swords are celebrated throughout India for their peculiar strength and edge, and are thus made:—An inch bar of fine Swedish or English steel is forged out into plates seven inches long, one inch broad, and one-sixth of an inch thick. Similar bars of fine, soft iron are prepared in the same manner. These are smeared with a paste of borax dissolved in water, and laid in piles of twelve—nine of steel to three of iron, or three to one alternately: each pile is wrapped round with a rag thickly plastered with mud made of a loamy earth; then heated, welded, and drawn out to a bar one inch and one-eighth broad, and one-third of an inch thick: this is bent zig-zag three or four times; is again welded and drawn out to half an inch thick; and, during the heat, borax is frequently dropped on the metal while in the fire. Two of these bars are next welded into one, and when about twelve or fourteen inches long, it is bent into the form of a loop or staple; in the middle of this a piece of fine-grained file is inserted, of the same width, and nearly as thick: all is then welded together, and the blade is formed.

#### *Tempering.*

An earthen pot twelve inches wide and six deep, is notched on the edges (the notches being opposite each other), with a file about a quarter of an inch deep, is then filled nearly up to the notches with water, and oil is then poured on the surface. The blade, being heated equally to a light red, is removed from the fire, and the point, entered into the notch on the edge, is passed to the opposite one, keeping the edge from a quarter to half an inch in the oil: it is drawn backwards and forwards rather slowly till the hissing ceases and the rest of the blade above the fluid has become black; a jug of water without oil is then poured along the blade from heel to point. In order to take out the warp produced by tempering, the blade, when nearly cold, is

passed over the fire three or four times; then being brought to the anvil, is set straight by striking it regularly, but moderately, with a hammer; by this means the Damascus-curved blade may be brought nearly straight. Blades made in this way in my brother's presence, when he was President of the regency in Cutch, were proved, previous to grinding, by striking at stones, ram-rods, musket barrels, and even wheel-tires, without injury to the edge.

Ibid.

*Silk Worms.* To meet the objections on the score of climate, I would suggest, first, that we ought to breed silk worms in hot-houses throughout the year; and, secondly, that the Pavonia Moths of Europe and other countries, as well as Atlas Moths of Asia, should be reared in like manner. It has already been remarked, that several crops are obtained in the east within the year; and why may we not also expect in England several, by means of breeding the worms in hot-houses. In India the longest period for a generation of silk worms appears to be forty days: even allowing fifty days in England for a generation, we may then expect seven crops of silk. If we only obtain four, that is double the number produced in Italy, where they annually rear but two. I need now scarcely add that four crops will repay the speculator for rearing silk. To reduce, however, the expenditure as much as possible, I would recommend him to feed the silk worms with lettuce instead of mulberry leaves; first, as there is less expense in the cultivation; secondly, as the lettuce can be grown cheaply in cucumber frames during the winter months; and, lastly, as the quality of the silk does not depend so much on the *quality* of the *leaf* as it does on the *degree* of temperature in which the worm is reared, I would strenuously recommend the lettuce. Should the food of the mulberry tree, however, be preferred to the lettuce, we can still adopt the discovery of Ludovico Bellarde, of Turin. His plan consisted in giving the worms the pulverized leaves of the mulberry trees slightly moistened with water: the leaves were gathered in the previous summer, dried in the sun, reduced to powder, and then stowed away in jars for the winter food, or till the tree was in full foliage. Repeated experiments made by Bellarde prove that the worm preferred this kind of food to any other, as they devour it with the greatest avidity. To reduce still further the expenditure, old men, women, and children might be employed in feeding the worms, as is the case at present in India: indeed, might not the poor in the work-houses be rendered available, thus affording them amusement and profit?

Ibid.

*Dr. Church's Steam-Coach.* We have much pleasure in stating that Dr. Church has at length completely and satisfactorily accomplished the construction of a steam carriage, in every way suited to run on ordinary roads.

The external appearance of the carriage is made exactly to resemble a stage-coach, and is about the same dimensions. It consists of a frame work with a casing enclosing the boiler and engines; the furnace, fuel-box, water chamber, and condenser, all of which hang upon springs, supported by the running wheels, require no auxiliary tender.

The casing is formed and painted like an ordinary stage-coach, the conductor sits, for the purpose of steering, in the place of a coachman, on the box in front; the engineer who attends the fire and the machinery, and has command of the steam, stands also in front, in an open compartment, below the conductor.

There are seats for the persons on the roof before and behind, as in other stage-coaches; but as this carriage is intended merely to be the loco-

motive engine for impelling a train of carriages connected to it, the seats upon this are to be considered as of an inferior class.

Some of the most important features of the locomotive carriage as now completed, viz. the peculiar construction of the boiler and arrangement of the working parts of the machinery, form portions of the subject of a patent granted to Dr. Church, on the 16th March, 1835; the specification of which, embracing other matters, is too elaborate for insertion in our present number, but will most probably appear in our next.

As several partially successful, but, in our opinion, very unsatisfactory attempts have been made by other persons, to impel carriages on ordinary roads by steam power, we consider it necessary to point out some of the peculiarities in Dr. Church's present carriage, which we consider to be its striking features of advantages.—Firstly, though the engines work at high pressure, the eduction steam is so effectually condensed after passing from the working cylinder, that no visible portion of it escapes into the air, but the whole is converted into water, and re-conducted into the boiler in a heated state. Secondly, the flues are so constructed and arranged, that no smoke is allowed to escape from the chimney; and the consequences of these two novel features, as regards locomotive engines running on ordinary roads, are very important, viz. that neither is there any perceptible noise arising from the discharge of steam, or any offensive effluvia emitted from the combustion, so that the carriage proceeds along the road without, in the slightest degree, attracting the attention of horses which may pass it.

We have only space to say further, that the Birmingham and London Steam-carriage Company, with whom the Doctor is connected in this invention, are perfectly satisfied with the carriage as now completed; and though alterations and slight improvements may and will necessarily be adopted in the future exercise of the plans, yet they deem the present carriage to be so fully effective and satisfactory, that they have advertised for a practical engineer to superintend the erection of a sufficient number of these carriages at their works, exactly according with the model produced.

We understand it to be the intention of the company to establish three stations between London and Birmingham for their trains of carriages to halt at, and to supply a fresh locomotive engine at each station, in order that the engines, after running about twenty-six miles, may be severally examined, and such little matters as cleaning, oiling, and adjusting parts attended to: which arrangement will avoid subjecting passengers to the inconvenience of delay, and tend greatly to prevent accidents.

We have only to add, that having witnessed the manner in which this carriage performs its duty on the public road, we have no hesitation in saying that we are now satisfied that steam may be safely, and, we believe, economically, employed, in connection with Dr. Church's improved machinery, as an effective substitute for horses, in the ordinary transit of stage-coach passengers on all the turnpike roads in the kingdom.

Lond. Jour. of Arts, Aug.

## **Progress of Civil Engineering.**

*Principles of Railway Transit, as they regard the force of traction, expense, and speed.* By JOHN HERAPATH, Esq.

*Force of Traction.*

If  $t$  denote the force of traction of a ton on a level, and  $z$  the angle of inclination of any plane,

$$t \cos z \pm \sin z,$$

is obviously the force of traction in ascending or descending the plane, the plus sign being used for ascending and the minus for descending. And because in all practicable railways  $z$  is very small, which gives  $\cos z = 1$ , and  $t$  by experiment about  $\frac{1}{240}$ , the force of traction is as

$$1 + \frac{h}{22} \text{ very nearly....(1)}$$

in which unity is the force of traction on a level, and  $h$  the height in feet per mile of the inclined plane.

### Expense of Transit.

Since this force of traction is the same for all velocities, it follows that, the load being the same, and the temperature of steam the same, the quantity of steam consumed, supposing it to follow in a column, would be the same for a given distance, whatever be the velocity; and as the distance run, that is, as the velocity, for a given time. Consequently, the expense, which I presume must be proportional to the amount of such steam so consumed, is the same for a given distance, at whatever velocity run. Therefore if  $l$  be the load,  $d$  the distance, and  $e$  the expense.

$$e \propto l \times d.$$

For two engines would be required under the same circumstances to tow a double load, three a triple load, &c.; and hence it is reasonable to infer, that the expense of the same engine exerting a double, triple, &c. force, would not sensibly differ, if at all, from the same rule. Consequently, if for  $l$  we put (1) multiplied by  $a$ ,  $l$ ,

$$e = (1 + \frac{h}{22}) a l d \dots (2)$$

where  $a$  is a constant to be determined from experience. It is hardly fair to apply the theorem in descending planes, particularly unless the descent is less than 22 feet per mile, owing in the first instance to the waste of steam by turning it off, and in the second to the breaks being generally used to check the descending velocity.\*

Now, according to the average experience on the Liverpool and Manchester Railway, the expense of transit, Mr. Dixon, the Company's intelligent engineer, informed me, is about a half-penny per ton per mile, though there are other railways, I believe, in which it does not exceed half of this sum, or a farthing per ton per mile. Hence  $l$  being the load in tons, and  $d$  the distance in miles, we have in pence,

$$e = (1 + \frac{h}{22}) \frac{l d}{2} \dots (3)$$

Under any other circumstances the 2 must be changed into the divisor of a penny, which the cost of transport happens to be.

### Velocity of Transit.

If we suppose a piston one-half the area of another, it must evidently travel with twice the velocity to consume the same quantity of steam at the same elasticity and temperature, and its force will, of course, be just one-half. Therefore a half load, under such a circumstance, would be driven with a double velocity. In the same way a third and a fourth of a

\* If  $h=22$  feet, it is obvious that  $t=0$ , or the friction of 240th would be in equilibrium with gravity without any assisting power. If  $h$  is greater than 22, there will be an accelerating force derived from the weight of the body, which corresponds to the negative value of  $t$ .

load would be driven with three or four times the velocity; and, generally, other things being alike, the velocity would be inversely as the load, the area of the piston varying as the load.

But supposing the piston and fire to remain the same, what would be the velocity of a double, triple, &c. load? This is a question which I am not aware has ever been satisfactorily answered, physically or experimentally. Indeed, on the received doctrine of airs, I do not think it admits of an answer. I shall endeavour to solve the problem physically, on the only reasonable principle I can imagine, and on laws of aeriform bodies published and constated with experiment by me fourteen years since in the *Annals of Philosophy*. Let it be distinctly understood, that not being quite certain of the principle alluded to, I do not offer it as a demonstrated solution; but I should be glad to see it brought to the test of experiment, and whenever it shall be, I do not expect it will be found much in error. If so, it will have the merit of bringing within the grasp of physical science one of the most important points in the action of the steam engine.

The principal referred to is this:—That the number of steam particles emitted every moment, drawn into the temperature of the steam, is always proportional to the heat simultaneously communicated by the fire to the water.

If, therefore, the heat communicated be uniform, and  $N$  denote the number of particles momentarily emitted, and  $T$  the true temperature of them,  $N T$  is a constant quantity.

But if  $E$  be the elasticity of the steam, and  $n$  the number of its particles contained in a given space,

$$E \propto n T^2,$$

by Prop. 8, *Annals for May, 1821*, p. 345. And if  $V$  be the velocity of the piston,  $n V$  is evidently as the number of particles of steam momentarily carried off or emitted. Therefore,

$n V \propto N$ , and  $T n V \propto N T$  a constant. Hence,

$$E \propto n T^2 \propto \frac{1}{TV} \times T^2 \propto \frac{T}{V} \propto \frac{\sqrt{F+448}}{V},$$

(according to Cor. 2, Prop. 1, p. 98, *Annals for Aug. 1821*)  $F$  being the Fahr. temperature. But  $E$ , the elasticity will be as the load or force of traction, and  $V$  as the velocity of the engine. Consequently,

$$\left(1 + \frac{h}{22}\right) l V \propto \sqrt{F+448} \dots (4)$$

Moreover, because when the elasticity of steam, at its proper tension, is tripled, the right hand member of the equation will increase only about 5 per cent. we may consider this member constant for all practical purposes; and hence the velocity of transit, other things alike, will be inversely as the load and force of traction.

We are now in possession of three rules of comparison, as simple and correct as, I believe, it is possible, in the present state of our knowledge, to make them.

First, the force of traction on any plane inclining with the horizon  $h$  feet per mile is,

$$9 \left(1 + \frac{h}{22}\right) \text{ lbs. up, or } 9 \left(1 + \frac{h}{22}\right) \text{ lbs. down}$$

per ton, allowing the draught per ton on a level to be 9 lbs.

Secondly, the expense of transit per ton per mile is, in pence,

$$\frac{1}{2} \left( 1 + \frac{h}{22} \right) \text{ up, or } \frac{1}{2} \left( 1 - \frac{h}{22} \right) \text{ down,}$$

supposing the steam at all times to act as the motive or retarding power.

Thirdly, the speed, if it be 30 miles per hour on a level, is

$$30$$

$$1 + \frac{h}{22}$$

We can hardly apply this formula to descents, unless they are very small; for if the descent was 22 feet per mile, it would make the velocity appear to be infinite in consequence of gravity doing all the work, and the object to be propelled amounting, therefore, to nothing.

For the more readily examining the capabilities and economy of any line, I have computed the subjoined table. The last column was computed by multiplying the third with 30, and as the succeeding decimals were not taken into account, it may not be quite correct in the decimal figure; but it is quite near enough for any practical purpose.

Elevation per mile in feet.	Force of Traction, in pounds per ton.	Parts of a load.	Expense per ton per mile in pence.	Velocity per hour in miles.
0	9.00	1.00	.500	30.0
2	9.82	.92	.545	27.6
4	10.64	.85	.591	25.5
6	11.45	.79	.636	23.7
8	12.27	.73	.682	21.9
10	13.09	.69	.727	20.7
12	13.91	.65	.773	19.5
14	14.73	.61	.818	18.3
16	15.55	.58	.864	17.4
18	16.36	.55	.909	16.5
20	17.18	.52	.955	15.6
22	18.00	.50	1.000	15.0
24	18.82	.48	1.045	14.4
26	19.64	.46	1.091	13.8
28	20.45	.44	1.136	13.2
30	21.27	.42	1.182	12.6
32	22.09	.41	1.227	12.3
34	22.91	.39	1.273	11.7
36	23.73	.38	1.318	11.4
38	24.55	.37	1.364	11.1
40	25.36	.35	1.409	10.5
45	27.41	.33	1.523	9.9
50	29.45	.31	1.636	9.3
55	31.50	.29	1.750	8.7
60	33.55	.27	1.862	7.1

JOHN HERAPATH.

Kensington, June, 1835.

Lond. Mech. Mag.

[Extracts from a communication to the London Mechanics' Magazine.]

*Daglish's Prize Rails and Pedestals.* I herewith send you drawings of my parallel rail and joint and intermediate pedestals, with the mode of fastening them to the stone blocks or sleepers, and also my method of keying the rails into their respective pedestal; for all which I obtained the premium lately offered by the London and Birmingham Railway Directors, with the exception of the mode of fastening the pedestals to the stone blocks, which the Committee of reference are said to have thought inferior to the lewis-pin of Mr. Swinburn, to whom the Directors accordingly awarded a third of the premium. I have also added sketches of certain modifications of my rail and pedestals, which it might be advisable to adopt under particular circumstances, and in some peculiar localities.

Fig. 1.



Fig. 3.

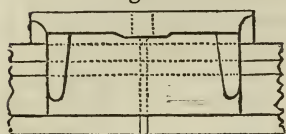


Fig. 2.

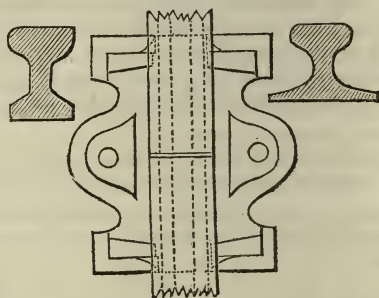


Fig. 1, is an end-section of the parallel rail and *joint*-pedestal (the pedestal where two ends of different lengths of rail meet); showing also the mode of keying the rail by cotter bolts. Fig. 2, is a plan of the above; and Fig. 3, a side section. The weight 50lbs. per yard. The stone blocks are from 10 to 12 inches thick, and contain from 4 to 5 cubic feet; the cotter bolts are  $\frac{3}{4}$  inch round.

Fig. 4.

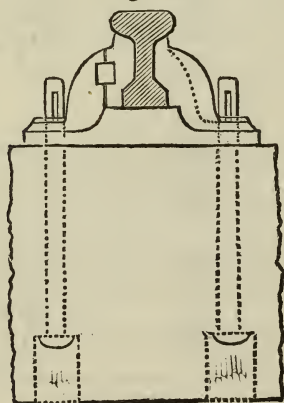
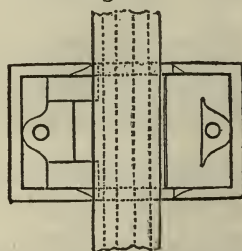


Fig. 5.



I have tried this form of rail against ten other forms of rail of the like weight per yard or thereabouts, not only by actually running heavy locomotive engines over them, but by means of the steelyard and lever, and have always found that it will carry more weight than any other with the

least deflection. The simplicity of its construction, too, is greatly in favor of its being soundly made.

Fig. 4, is an end section of the same kind of rail, with the *intermediate* pedestals; and Fig. 5, plan of the same.

The joint-pedestal is made of nearly twice the bearing of the intermediate ones, in order that the ends may be the more effectually secured.

Mr. Barlow made his experiments with my form of rail, which he pronounces to be by far the best, and recommends the mode which I proposed of fixing the pedestal to the stone block, *and not Mr. Swinburn's*.

Indeed, to all who are practically conversant with railways, it must seem as inexplicable as surprising, that the lewis-pin method should have been thought worthy of favorable mention at all, far less of being honoured with a premium. Were such a mode of fastening adopted (as it most assuredly never will), it would not be long before the concussions from the passage of heavy locomotive engines, at great velocities, would infallibly split the stone to the depth of the lewis.

The mode of fastening practised by me, and approved of by Mr. Barlow, consists, as will be partly seen from inspection of the figures, in inserting plain cotter bolts through the stone, and countersinking the hole up from the bottom for the space of an inch and a half or two inches, so as to permit the point of the bolt to drop below the base of the pedestal. I first tried screw-bolts, but was obliged to abandon them in consequence of the nuts getting, through corrosion, so fast to the bolts as to twist the bolt-ends off before they would unscrew. Fifteen years' experience has now satisfied me that the plain cotter bolt is the only one that will answer.

Mr. Barlow, speaks of this method of fastening as if it were the suggestion of Mr. Vignoles. But how he should have fallen into such a mistake, I cannot comprehend; for it was not only fully shown in the models I sent in to the London and Birmingham Railway Directors, but the advantages of it were particularly dwelt upon in the letter which accompanied them. To place this beyond all doubt, I will here repeat those passages of my letter which relate to this point:—

“The pedestal for the joint I would particularly recommend to be fastened to the sleeper with cotter bolts; I would also prefer fastening all the intermediate ones in like manner, though they would answer to be well nailed in the usual way, but much better with cotter bolts, as you then derive the greatest effect from the parallel rail, by keeping every pedestal firmly down. If only nailed, this may prevent the intermediate pedestals becoming fulcrums, in which case the fibres of the upper surface of the rail are not called into tension in the same ratio with those on the under side of the rail, immediately between the pedestals, while the locomotive or any other heavy carriages are passing along the line.”

Again:—

“I prefer the mode of fastening the pedestals with cotter bolts as by far the most effectual for general use; if even they have to be fastened with smaller bolts (say  $\frac{3}{8}$ ths diameter), more especially when they can be thus secured at as cheap a rate as if fastened by nails. The holes for the small bolts can be drilled through the stone sleepers for less than the large holes necessary to receive the wooden plugs; and the small bolt and cotter will only cost a trifle more than the nail and wood plugs, as both the bolts and cotters can be made by a machine for that purpose.”

Mr. Vignoles, though he certainly did not suggest the use of the cotter bolt, has done me the honour to cause it to be adopted in the construction of the Dublin and Kingstown Railway, instead of the nails or spikes commonly used.

Mr. Barlow makes some very forcible observations on the importance of exact fitting and fastening; but to show you that all practical men have not been so indifferent to these matters as Mr. Barlow imagines, I will, with your leave, make another short extract from my letter to the London and Birmingham Railway Directors, which has an immediate bearing upon this part of the subject:—

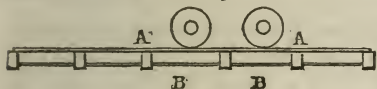
“I am quite sure a velocity of from 50 to 60 miles per hour may be obtained upon a well-constructed railway, with greater safety than one of 20 miles, upon any of the present lines yet in operation; not only from their having too light a rail and ill-constructed pedestal, but from the mode of fixing them, *especially at the joints*, which is the great cause of so much deflection and sudden action, both vertically and horizontally—so that it is not in the power of man to make a locomotive engine to stand the action they are subject to long together.

“I have frequently stated to companies, that every public railway ought to be laid down as accurate and as firm as it is possible for hands to do them; and, when that is done, to put a steam engine upon them to plane the surface, the same as we do our slide rails.”

I must also use the freedom to observe that, correct as Mr. Barlow's views are, of the importance of executing all railways in the best possible style of workmanship, he shows in nearly all that regards the details, great want of practical knowledge. Speaking of keying the rails to the pedestals, he says, that “if the rails and chairs be not permanently fixed to each other by direct means, it ought not to be attempted by indirect means, viz. by cotter keys or wedges, for either these will hold the rail to the chair, or they will not; if they do hold fast, they produce all the mischief which permanent fixing would occasion; and if they draw, then they do no good, although they may still do mischief.” Now, if the Professor ever had an opportunity of carefully watching for a summer's day the passing of heavy steam carriages and long trains of other heavy carriages over a railway, he would never have ventured such a statement. He would have witnessed, that it is scarcely in the power of man to fasten the rails permanently to the pedestals. Aware of the impracticability of doing so, I do not allow the D key proposed by me (see fig. 1), when used to key the rail to the *joint*-pedestal, to be driven with more than a single-hand hammer; and also stop it at its place when driven, the key being here merely intended to act as a steadiment to the rail. For before a locomotive engine or heavy train has passed twice over the rails, the whole of the keys give or yield of necessity in such a manner as to allow the rails to expand or contract more than what they really do, or are subject to, from the differences of temperature to which they are exposed. With respect, however, to the *intermediate* pedestals of the five-yard rails, the more soundly they are keyed to the rail the better, so as not to injure the pedestal by over-driving the key, as there is more latitude in the holes through the base of the pedestals where the bolts pass, than would compensate for treble the expansion and contraction the rails are subject to. Besides, each of the holes drilled through the stone blocks upon which the pedestals rest, is drilled  $\frac{1}{8}$ th of an inch larger than the diameter of the bolts, and the pedestals can never be so hard cotted down to the surface of the stone but what they will give a little. All difficulties on this head I got completely over several years back, in both wrought and cast-iron railways which have been laid under my direction. I could refer Mr. Barlow to several miles of railway which have been worked for years, and remain at

present perfectly firm without the least distortion, either vertically or horizontally.

Again: notwithstanding Mr. Barlow has actually proved by experiment that the parallel rail is superior to the parabolic, or fish-bellied rail, and has taken some pains to show the neutral axis, which has little or nothing to do with the best form of rail; yet he has forgotten to point out one of the most essential advantages which the parallel rail has over the parabolic rail, as I have frequently proved by the steelyard-lever. I have found that by holding the ends of the rails firmly down, at the joint-pedestal especially, the parallel rail of fifty pounds per yard will carry upwards of a ton more, with the same deflection, than the ends will do if they are allowed to rise, which they will of course do, if the end-pedestals are merely nailed down in the bad and ineffectual manner hitherto usual, namely, by common nails or spikes. When the rails are kept firmly down by proper means, the intermediate pedestals become so many fulcrums, and the tension of the fibres of the upper parts of the rail is called into play; as will be readily understood from inspection of the following diagram, in which A A represents the points of tension, and B B the points of deflection.



I perceive further from Mr. Barlow's experiments, that he considers that the

best rail for strength ought to be from  $4\frac{1}{4}$  to  $4\frac{1}{2}$  inches deep, from the upper to the lower surface. I am quite confident, however, that it will be found that the best form of wrought iron rail ought not to exceed  $3\frac{3}{4}$  inches deep, or 4 inches at most; for by making the rail higher, not only will the pedestal be much weakened, but there will be no possibility of holding the pedestals firm on their base, by cotter bolts or any thing else, more particularly at the shunts and curvatures of the line of railway, and even the stone blocks will be continually shaken. It is well known in practice, that the lower any rail and pedestal can be kept, the less is the destruction in them, and the less the action on the foundation upon which the stone blocks are placed. It is also equally well known, that a sufficient wrought iron rail can be made of the depth I have stated, (namely,  $3\frac{3}{4}$  or 4 inches), to resist the action of a locomotive of 12 to 14 tons weight, at a speed of 40 or 50 miles per hour, (or even more if necessary,) if it is properly laid and adjusted.

I find that the different railway companies are now going to have their rails manufactured to weigh as much as 60lbs. per single yard. The additional 10lbs. per yard, ought, in my humble judgment, to be employed partly to strengthen the lower edge and make it rest more firmly on its basis, and partly to increase the width of the upper surface; both in the manner shown in fig. 6, which is a sectional view of what I consider the best form of a rail of this weight. My object in these modifications, is to increase the adhesion of the locomotive-engines, as well as to give a little more bearing on the peripheries of their wheels, in order to make them last longer.

I understand the Directors of the Birmingham and Liverpool Railway (the Grand Junction), have recently given an order for one or two thousand tons of parallel rails, the upper and lower edges of which are both alike. Now, the fact is, that twelve months ago, I gave one of their engineers a set of drawings, of rails and pedestals, of a variety of forms, *and this was one of them.* And in my letter to the Directors of the London and Bir-

mingham Railway, before quoted from, I also expressly made mention of this form of rail, as one that *might* be employed; but pointed out, at the same time certain objections to its use, which restrained me from proposing it for adoption. My words were these:—

“I have hesitated with myself, whether or not to make a pattern with the upper and lower edges exactly alike, so as to be able to use either side, in case the former should prove a little unsound in any part, which has hitherto been frequently the case, especially at the ends, as I am fully aware that the more metallic material that can be brought to the lower side, adds considerable strength to the rails; but as you seem disposed not to exceed 50lbs. per single yard, a little would be lost in the depth and height of the rail. Allow me to assure you, that no public railway company will ever regret having sufficient strength in the rails at the beginning, and that they ought not, by any means, to confine themselves to a pound or two in the yard, in order to make the work as complete and substantial as possible at the commencement. But, as it is, after mature consideration, and taking every thing into question, I prefer the models I have furnished (Nos. 8 and 9), as the keys will be more effectual.”

Fig. 8, is a section of the form of rail that I recommended, and would still recommend, for adoption where it is desired to construct it, so that it may be inverted if necessary. It is what I call a “fancy rail,” but ought to weigh at least 55 lbs. per yard.

Fig. 8.



Fig. 9.



Where a railway is intended for locomotive engines of only from eight to ten tons weight, a rail of the form represented in fig. 9, and weighing only 45 lbs. per yard, will be found to answer sufficiently well.

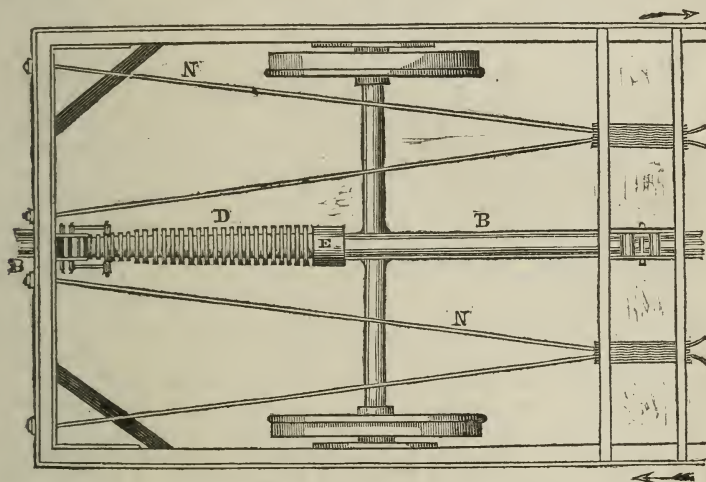
For America, where they have great difficulty in obtaining stone blocks, and are in the custom of fixing their rails on wooden sleepers of lengths varying from 30 to 50 feet, secured by cross sleepers, the best form of rail is that shown in fig. 7. I have been informed by American engineers that they can get plenty of a hard durable timber, very suitable for the purpose, for little more than the expense of cutting it down in the forests, and sending it to the saw mills to be cut into scantlings fit for immediate use; and that a railway bed of this description will last for nearly twenty years. Sometimes they lay their rails on cross sleepers only, dispensing with the side pieces. Several orders for rails of the form above referred to, are now executing under my inspection for railway companies in America.

Lond Mech. Mag.

*Bergin's Patent Railway Buffing Apparatus.* Immediately after commencing the traffic on the Liverpool and Manchester Railway (the first on which long trains of carriages were moved by locomotive engines at high velocities), it was found that every time a train was put in motion or stopped, violent concussions took place between the several carriages, equally disagreeable to the passengers and destructive to the carriages themselves. These concussions arose from the following cause: viz. by reason of the inertia of all heavy bodies, the same engine power which would be adequate to draw a given load along a railway at any required speed, would not be sufficient to start the same load from a state of rest; it was therefore necessary to connect the several carriages by chains of some considerable length, say three or four feet, by which arrangement the

inertia of the train was, as it were, divided into as many parts as there were carriages, and these several parts being each within the power of the engine, were overcome in succession; but as the first carriage would have attained a certain amount of velocity when the connecting chain came to pull the second, this second must of course be at once dragged from rest into motion at a speed nearly equal to that already acquired by the first, and so on through the entire train. Now a very slight knowledge of the principles of mechanics teaches that the concussions already mentioned were the necessary result of the action described; the same principle (inertia) produced the same effects at stopping a train, and also at every change in the relative velocities of the individual carriages when in motion; and as the force of these shocks was dependent on the velocities, the greater the speed of traveling the more violent they became.

The obvious remedy for the evil complained of was to provide a means by which the full amount of motion acquired by any part of the train should be gradually, not instantaneously, communicated to the other parts; the elasticity of a spring was a suitable means, and an apparatus was accordingly added to the Liverpool and Manchester passenger coaches, a sketch of which is annexed, and which has been termed a buffing-apparatus.



This apparatus is complex and consequently expensive; it also requires to be very strong, as on a little consideration it will be evident that the spring-bars, levers, and frame of the first carriage have to bear the resistance of the entire train; a very rigid spring is therefore necessary, the range of action of which is, of course, very limited, (in practice not exceeding a few inches,) consequently the concussions, although much diminished, are still very considerable. The apparatus being attached to the carriage-frame, which is, of course, supported on bearing springs, it rises and falls according to the load; whence it constantly occurs, from the carriages being unequally weighted, that the buffer-heads, opposed to each other, and which by right should be at the same level, vary by nearly their own diameter. Whence, in the event of a violent blow, the bars to which they are fastened are almost certain either to be bent so as not to play in their sockets, whereby the whole apparatus becomes inoperative; or else to be broken off,

(such we have found to be the case in every instance when an unusually severe blow took place). After the apparatus described was added to the Liverpool and Manchester carriages, it was found that the train no longer proceeded in a steady motion in the direction of the rails, but that each carriage had acquired a very considerable lateral motion, by which the flanges of the wheels were constantly striking or rubbing against the rails, so as to cause a considerable increased resistance from side friction; indeed, on looking along a train of six or eight carriages, the serpentine motion is very striking. The cause of this unsteady motion will be evident, when we recollect that the point from which each carriage is drawn is in one direction, the centre, and in the other the after extremity. These considerations, the result of numerous careful examinations of the carriages on the Liverpool and Manchester Railway previous to ordering our own, led me to seek for a remedy; as on the Dublin and Kingstown Railway, so very large a proportion of the traffic of which would be passengers, the extent of which it would be difficult to anticipate, but which must of necessity be immense, it became a matter of paramount importance to attain, as far as practicable, the most perfect comfort and security, and also to reduce as much as possible the wear and tear of the numerous carriages which the company must provide. The apparatus which I designed, and which has been successfully applied to thirty-five of our carriages may be thus described.

A slight frame of sheet-iron, consisting of two similar plates, three inches apart, each about  $\frac{3}{16}$  thick, secured together by rivets, rests on turned bearings on the centres of the axles; a single bar B (I have used a welded iron tube of  $\frac{5}{16}$  inches thick and three inches diameter, as being the stiffest), the entire length of the carriage, and extending about two feet beyond each end, passing through an oblong hole about three inches wide and nine inches long, is supported on this frame by rollers, allowing it to be moved lengthwise with great facility; on this tube or bar B is placed at either end (within the framing of the carriage) about four feet of spiral springs, D, of graduated strengths; one end of each of these sets of springs rests against a strong collar or boss, E, fixed to the bar or tube, and the other end against a small box of iron, attached to the frame and furnished with one of the rollers previously mentioned, also with two friction rollers projecting a little beyond its surface, and resting against the inner side of the carriage-frame end. To each extremity of the tube B B is attached a buffer head, by means of a bar of iron, passing through B B, and furnished with a nut and screw at each end; immediately within the buffer head, and resting against it, is a bar of iron, for attaching the carriages together. It will be observed, that this apparatus, lying loosely on the axles, is perfectly independent of the frame work of the carriage, which is supported in the usual manner on bearing springs, and, in consequence of the oblong holes rises or falls according to the load, without affecting the buffing-apparatus. The action of the apparatus is as follows:—The train being to be moved in the direction of the upper arrow, the motive power is applied and draws onward the central tube B B, thereby compressing the springs D between the boss E and the friction roller-box which rests against the end of the carriage-frame, without moving this latter until the elastic force of the compressed springs becomes sufficient to overcome the resistance presented by the friction and inertia of the carriage, when the latter begins to move forward so gently as not to be perceptible to persons seated there-

in; the second and each succeeding carriage in the train is by similar means brought from a state of rest into motion, as (altogether independent of the springs D) the tube B B acts merely as a simple connecting chain, rope, or bar, would. In case of a concussion from behind, or of one carriage running against another, it will be at once seen that the resistance is offered by the furthest end, the effect being to drive the tube B B forward, compressing the springs at the remote end; and the carriage will not be affected by the blow until (as in drawing the train) the elasticity communicated to the springs overpowers the inertia of the carriage, which then begins to move, actuated by a force just sufficient to start it; any ordinary velocity might be thus, theoretically, resisted by sufficient length of spring, without any strain or violence to the carriage receiving the blow; but, practically, the springs are limited to about four feet, allowing a range of action of about two feet, beginning to be compressed by a force equal to about twenty pounds, and presenting a gross resistance to entire compression of upwards of two tons, and which have been found sufficient for all practical purposes. It will be observed, that as the springs of each carriage act totally independent of each other, and of all the carriages in the train, except that to which they are attached, each has but to bear its own share of the resistance, the sum of which is made up of the separate resistances of all the springs acted on: thus, if one set offers a resistance equal to two tons receding through two feet, and that there be ten carriages in the train, the gross resistance to a concussion would be equal to twenty tons through two feet; and if the buffer-heads of each carriage were in contact, this great amount of resistance would be opposed without the carriages being necessarily moved forward as in the case of any obstruction on the rails, or any of them bearing more than two tons. On the contrary, in the other apparatus, supposing each spring also to resist a force of two tons, and to recede, as is the case in practice, about eight inches, each spring being acted on by all that preceded it, the resistance offered by a train of ten carriages would be but equal to two tons through ten times the space each separate spring moved, or  $10 \times 8 = 80$  inches, or six feet eight inches; consequently the first and each succeeding carriage would, to enable all the springs to act, be forced through a space equal to the sum of the spaces through which the separate springs act; thus the first carriage of the ten would be forced through eight inches for each of the remaining nine carriages, or in all six feet, and it is easy to conceive the difference of the effect in the two cases. Experiments have been tried on this railway, by placing a single carriage, fitted with the new apparatus, on the rails, and running an engine and tender against it with a velocity of six to seven miles an hour, without producing any injurious effect. I have more than once sat in a carriage so struck, without sustaining any injury, or other effect, greater than is felt on starting a train of carriages fitted with the old apparatus.

Another effect which has been realised by the adoption of this apparatus, is a perfectly steady forward motion in the trains, whereby very much of the side friction of the flanges of the wheels against the rails is avoided; and instead of that undulating, lateral motion previously described, all the carriages constituting the train move forward in a steady path, as if they had not the power of motion independent of each other. Carriages are hereby rendered much less liable to go off the rails, and can be pushed before the engine in case of necessity with far greater confidence and less liability to accident; as although the impulse is given to the central bar from

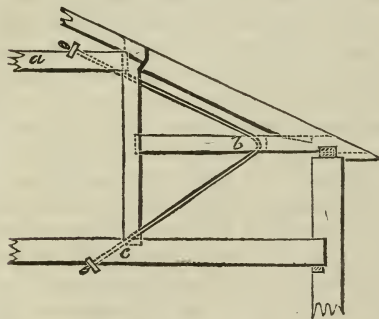
behind, yet it is obvious the carriage is acted upon from the front, precisely as it would be if drawn in the same direction. I have frequently, during our experimental trials before opening the railway, propelled one and two carriages in this manner at a velocity of thirty miles per hour with perfect safety. The diminution of side friction necessarily diminishes the power requisite to draw a train: the amount of saving in this respect I have as yet been unable to ascertain experimentally with sufficient accuracy to state in this place; I have, however, ascertained that it is very considerable.

One other object, of no trifling importance to a concern like the Dublin and Kingstown Railway, which must have an exceedingly large stock of carriages, is also effected; namely, a diminution of first cost of between 50*l.* and 60*l.* per carriage.

In describing the figures, I omitted to state that as the entire resistance to the action of the springs *D* is on the ends of the carriage-frame, the centre of each is armed with a strong plate of iron, about fifteen inches square, through which pass the tension rods *NN* to the outer angles of the opposite ends of the frame; consequently these rods receive the entire force of the springs. *Lond. Mech. Mag.*

*Description of a new method of forming a Tie to a roof, where a direct Tie from Wall Plate to Wall Plate cannot be introduced.* By *W. COLES, Esq., Architect.* Fig. 214, is a plan which I have found answer well as a tie to a roof, where a direct tie from plate to plate could not be introduced; and, as far as I know, it is original. I introduced it in this neighborhood in the roof of a cottage, in a case where the walls, having been carried up about four feet above the floor of the attic story, a direct tie across the building would have prevented the communication from one room to the other.

Fig. 214.



tie *b*, and down through the floor-joint at *c*, and is tightened with a nut and screw at each end.

*Kingsgate Street, Winchester, April, 1835.*

*Lond. Architect. Mag.*

## Mechanics' Register.

*Halley's Comet.* The comet of 1835, when it came in 1456, was encountered by the anathemas of the whole Catholic Church, headed by the Pope. Dismayed at once by the progress of the Turks and the progress of the comet, Calixtus included them both in the same prayer of conjuration ordered to be said in all the churches.

It came again in 1531, and found America discovered, printing invented and in general use, and the reformation begun.\*

1607 again completed its cycle. And now the *Copernican* system had been published to the world;† the *telescope* had been discovered; Galileo and Kepler had been born, and had probably laid the foundations of their discoveries, the one in mechanics, and the other in astronomy.

Next came 1682 and the comet, and the laws of motion were ascertained and published to the world; the discoveries of Kepler were made, and Newton had built up upon them the theory of universal gravitation.

1759 was to be the next period of its appearance, and its coming was now, for the first time, *foreseen*. Halley, afterwards Savilian Professor at Oxford, having undertaken to calculate the orbits of different comets which had, up to that time, been observed, presented, in 1705, to the Royal Society, a work called *Cometographia*, in which he predicted‡ the return of the comet of 1682 in 1758, an announcement received in those days with no little surprise and interest. It was, however, immediately foreseen by astronomers, that the path of this comet would be disturbed by the attraction of the planet Jupiter. Lalande and Clairaut undertook to calculate the amount of this disturbance. The work was one of enormous labour, which they would never have undertaken, as Lalande himself admits, had not assistance been rendered to them (strange to say) by a lady. To Madame Lepaute, the wife of a celebrated watch-maker in Paris, was assigned a principal portion of their calculations, and to that lady is due a principal share in their success. "During six months we calculated from morning till night, even during meals," says Lalande. They determined the actual perturbations, during 150 years, of Jupiter and Saturn, and they arrived finally, at the conclusion, that its coming would be delayed no less than 518 days by the attraction of Jupiter, and 100 more days by Saturn. The time of its perihelion passage§ was thus brought to 13th April, 1759: it was, nevertheless, stated that errors might have been made amounting to a month either way.

These conclusions Clairaut published to the world in November, 1758, when astronomers had already begun to look for the comet. It was first seen by a farmer of the name of Palitzsch, near Dresden, on December 25, 1758, and at Paris, on January 21, 1759. It passed its perihelion on March 13, 1759, just one month after the time predicted.

The comet of 1759 was next to complete its orbit in 1835; and of its appearance in that year an account will shortly be given, when we shall first have answered two questions, which will, no doubt, have suggested themselves to every one who has read so far of this paper. They are these:

The comet of 1835 was, in its last revolution, influenced appreciably by the attractions of the four planets, Jupiter, Saturn, Uranus, and the Earth, and of course by the attraction of the Sun; and MM. Damoiseau and Pontécoulant, severally and independently, undertook the task of calculating their amount, and, separately, completed it. M. Pontécoulant found that the action of Jupiter would, as compared with the last revolution of

\* This time it was accurately observed by one Apian, a Professor of mathematics, at Ingelstadt.

† The great work of Copernicus, *De Revolutionibus*, was published in 1543.

‡ His words, translated, are, "Hence I dare venture to foretell that it will return again in 1758."

§ This term will be explained in the course of this paper.

the comet, on the whole accelerate it 135.34 days; that of Saturn, retard it 51.53 days; that of Uranus, retard it 6.07 days; and that of the Earth, 11.7 days. The principle portion of the influence of the Earth on its motions, dating as far back as the year 1759, or the very beginning of its revolution, at which time it passed very near the Earth.

Allowance being made for these, the whole period of the comet's last revolution was brought to 27937 days, and counting from the 13th of March, 1759, when it last passed through its perihelion, or nearest extremity of its orbit to the sun, this brought its next perihelion passage to the 13th of November, 1835.\* At the same time M. Pontécoulant expressly stated, that there might be an error of a few days in this time, and assigned as a proximate cause of such an error, a possible incorrectness in the assumed masses of some of the planets. His words are, "we must here once more repeat, that it is not pretended that the time announced for the comet's return to its perihelion may not be in error some days." Elsewhere he says, "Thus then it is *conclusive that about the middle of November, 1835, the passage of the comet through its perihelion will take place.*"

We next compare the results with the predictions. It had been announced that the comet would probably be visible during the first days of August. *It was seen on the 5th of August, at Rome,† by MM. Dumouchel and Vico*, its light being then exceedingly feeble. But more than this, the *precise place* in the heavens which the comet would occupy on every day whilst it should be visible, had been calculated and announced beforehand, and *it was when they directed their telescope to that point in the heavens which had been so predicted for the 5th of August, that MM. Dumouchel and Vico saw it.* It had been foretold that it would pass its perihelion on the 13th of November, that there might be an error of a few days, but that, nevertheless, it certainly would pass it about the middle of November. *It passed its perihelion on the 16th of November.*

It had been assigned by M. Pontécoulant, as a reason for the uncertainty which he thus felt in respect to the time of the perihelion passage, amounting, however, only to a few days, that the masses usually assigned to some of the planets by astronomers, and used by him in his calculations, might require correction. Of all the planets, Jupiter exercised the greatest influence over the motions of this comet. Any error in the mass which had been assigned to Jupiter, would, therefore, most affect the result. Now the mass he had assigned to Jupiter, was such, that 1054 such masses would equal the mass of the sun. Recent observations have shown, that the mass of Jupiter repeated only 1049 times, would equal the mass of the sun; and it has been ascertained, that *if M. Pontécoulant had used in his calculation this corrected measurement of the mass of Jupiter, instead of that which he did use, it would have protracted the predicted time of the perihelion passage three days, and brought it to the 16th, and to within six hours of the time when it actually took place,—an error of six hours in a period of seventy-six years!* Lond, Mag. Pop. Sc.

**Gas Lighting.** On Feb. 28, at the Royal Institution, after a brief sketch of the origin and progress of gas-illumination in London and its environs, Mr. Brande proceeded to details connected with the present state of the manufacture, illustrating the various sources of its extension and improvement. He began by adverting to the curious and complicated pro-

\* M. Damoiseau fixed its perihelion passage to the 4th of November.

† The reader need not be reminded how pure and clear is the atmosphere of Rome.

ducts resulting from the destructive distillation of pit-coal; the principal elements of which he stated to be carbon, hydrogen, oxygen, and nitrogen, in conjunction with sulphur and iron derived chiefly from pyrites; these substances, by their mutual action during the application of a heat gradually raised to redness, yield olefiant gas, carburetted hydrogen, hydrocarbonous vapours, naphtha, naphthalin, tar, carbonic acid and oxide, cyanogen, hydrocyanic and sulphocyanic acids, sulphuretted hydrogen, ammonia, and several of its salts, water, and certain other products, of which a copious table was shown, containing also a statement of the relative proportions of gas, condensable products, and coke, afforded by three varieties of coal. Models and drawings of gas apparatus were then described, especially as illustrating the different modes of setting the retorts; and the progress of the gas from them was traced through the hydraulic main, where the tar, water, and ammoniacal liquor, are chiefly deposited to the condensers, purifiers, and gasometers. Some observations were then made in reference to the uses and properties of the various products, in the following order:—

1. *Ammoniacal Liquor.* This was shown to be a complicated solution of several ammoniacal and cyanic compounds in water. It is extensively used for the production of muriate of ammonia, which is obtained by saturating it with muriatic acid, evaporating, crystalizing, carefully drying the crystalized salt, and subliming it into large leaden receivers. A beautiful specimen of this salt, prepared by Mr. Leeson, of Greenwich, and weighing 2 cwt., was exhibited. Sulphate of ammonia is also prepared from the liquor; this, in its dry, crystalline state, is mixed with carbonate of lime, and affords carbonate of ammonia, of which a large mass, prepared by Mr. Leeson, was also shown. The presence of sulphocyanic and hydrocyanic acid in the ammoniacal liquor was shown by saturating it with muriatic acid, and adding persulphate of iron: the detection of these compounds and their application to the manufacture of Prussian blue, Mr. Brande said was owing to the skill and ingenuity of Mr. Lowe. This product, therefore, of the gas manufacture, once considered as useless, yields a variety of useful and important compounds, and has opened a new field of chemical art.

2. *Tar.*—This product is useful as a coarse paint, and for the purpose of paying and caulking vessels: it is also more importantly applicable as fuel in the gas-works, where, mixed with water, it is suffered to dribble into the fire; three gallons of this mixture per hour being sufficient to heat five retorts. When distilled, it yields naphtha, a highly volatile and inflammable liquid, which is occasionally burned in lamps, or used as a solvent in the manufacture of certain varnishes.

3. *Lime Liquor.*—This is the mixture of lime and water, through which the gas has been passed, chiefly with a view of freeing it from carbonic acid and sulphuretted hydrogen: it is from time to time drawn from the purifiers and suffered to subside. The deposit, or thick portion, is made again into lime, or is used for luting the retort-lids; the clear portion is pumped into shallow vessels placed in the ash-pits of the retort-furnaces, where it evaporates, and tends to preserve the bars, probably by keeping them cool. Another use, however, is now made of it, as follows:—Acid persulphate of iron (copperas liquor) is added to it, which throws down a green precipitate, that may itself be used as a paint, but which, digested in a solution of potash, yields a ferrocyanate of potash, sufficiently pure to throw down Prussian blue from common copperas liquor.

4. *Gas.*—The specific gravity of the purified gas, and, consequently, its

composition, vary considerably at different periods of the distillation; its average specific gravity, as taken from the gasometers, is 0.410; each cubic foot weighing 240 grains. After some remarks upon the manufacture of gas generally, and upon the various forms of carbon, and other products occasionally found in the retorts, Mr. Brande made some observations upon the sources of the luminosity of different gases, and on photometers; and then proceeded to details connected with the process as carried on upon the large scale by the different companies; stating that his experience was chiefly derived from the Chartered Gas Company, the officers of which had most assiduously assisted him in all inquiries connected with the subject generally, and with the particular object of the present inquiry; Mr. Lowe, and Mr. Frederick Winsor, had kindly given him access to their information; and Mr. Crossley had supplied models of gas-meters and their appendages, with much of the other apparatus upon the table. Mr. Brande estimated the number of retorts worked by the above-mentioned company at 750; and assuming them to be about one-fourth of the number employed in London, the whole amount will be 3,000 retorts, of about 15 cwt. each; so that the cast iron thus employed, to say nothing of the enormous amount in pipes and other apparatus, amounts to 2,240 tons. The total stowage for gas in the gasometers of the chartered company, Mr. Brande estimated at 820,000 cubic feet; or, for London, 3,280,000 cubic feet. He said, that the number of burners supplied by this company amounted to about 42,000; or, for the whole of London, to 168,000; and, estimating the consumption of each burner at five cubic feet per hour, the average *hourly* consumption of gas would amount to 840,000 cubic feet; and taking five hours per day as the average time of burning, we have 4,200,000 cubic feet of gas as the daily average consumption. Mr. Brande concluded by explaining the different checks resorted to by the companies in reference to the quantity of gas produced and consumed; and by a description of the gas-meters, pressure-gauges, tell-tales, and governors, all illustrated by a series of excellent models and apparatus. The following tables were exhibited, as furnishing data and details connected with several of the points referred to in this lecture, together with some others which we have not room for, showing the relative weights and volumes of gas, and of the consumption of atmospheric air in its combustion:—

For the total annual supply of gas to the metropolis, there are required 200,000 chaldrons of coal, yielding 2,400,000,000 cubic feet of gas; the gas weighing 75,000,000 lbs. The light thus produced is equal to 160,000,000 lbs. of mould candles, of six to the pound; the bulk of the coal is equal to 10,800,000 cubic feet, or 400,000 cubic yards; or to a cube of 222 feet in the side, or of 74 yards. *Arcana of Science, 1835.*

*List of American Patents which issued in June, 1836.*

(CONTINUED FROM PAGE 215.)

453. <i>Dry dock.</i> —J. Houston, A. Kinman, & J. Ingraham, Buffalo, N. Y.	22
454. <i>Horse collars, forming.</i> —G. Warner and R. Robinson, Canajoharie, N. Y.	22
455. <i>Raising water.</i> —Jesse C. Wood, Euphrata, N. Y.	22
456. <i>Fence pickets, cutting.</i> —J. Tichnor, S. Goodrick, & G. A. Hart, Ithaca, N. Y.	22
457. <i>Straw, corn, &amp;c. cutting.</i> —E. Tarbox and C. F. Kneeland, Ogden, N. Y.	22
458. <i>Wheel plough.</i> —J. C. Ferguson, Hydesville, Missouri,	22
459. <i>Wagon tilts.</i> —Stephen Beebe, Norwich, Conn.	22
460. <i>Cotton, spinning.</i> —William P. Brayton, N. Y.	25
461. <i>Chocolate, grinding.</i> —G. W. Wait, Baltimore,	25
462. <i>Chocolate, moulding.</i> —G. W. Wait, Baltimore,	25
463. <i>Chocolate ingredients, heating.</i> —George W. Wait, Baltimore,	25
464. <i>Churn.</i> —Samuel Tyler, New Gloucester, Maine,	25
465. <i>Planing machine.</i> —P. M. Martz, Marion county, Ind.	25
466. <i>Oven, reflecting.</i> —Benj. Ames, Ithaca, N. Y.	25
467. <i>Hair and oakum, picking.</i> —Robert B. Lewis, Hallowell, Maine,	25
468. <i>Cooking stove.</i> —Gould Thorp, N. Y.	25
469. <i>Water heating machine.</i> —D. B. Barnum, N. Fairfield, Conn.	25
470. <i>Distilling.</i> —Peter Swartz, Jr. Muncey, Penn.	25
471. <i>Cooking stove.</i> —Thomas Shaw, North Yarmouth, Maine,	25
472. <i>Flyers for cotton spinning.</i> —Jason Morse, Newtown, Mass.	25
473. <i>Water wheels.</i> —Orson Waldo, Newark, Tioga county, N. Y.	25
474. <i>Palm leaf hats.</i> —Fred. Groening, Brooklyn, N. Y.	25
475. <i>Planing machine.</i> —Ira Gay, Dunstable, N. H.	25
476. <i>Thrashing machine.</i> —Peter Cleveland, Yancy mills, Va.	25
477. <i>Rotary steam engine.</i> —Shepherd Whitman, New Albany, Ind.	25
478. <i>Parlour grates.</i> —William Anderson, N. Y.	25
479. <i>Boot cramp.</i> —Hubbard L. Pierce, St. Johnsbury, Vt.	25
480. <i>Vegetable cutter.</i> —Henry Mellish, Walpole, N. H.	25
481. <i>Saddles.</i> —Benjamin Kraft, Reading, Penn.	28
482. <i>Compass, surveyors.</i> —Nathan Bassett, Wilmington, Del.	28
483. <i>Harvesting machine.</i> —H. Moore and J. Hascall, Kalamanzo, Mich.	28
484. <i>Cars, Rail Road attaching.</i> —L. Pickering and J. Lightner, Boston, Mass.	28
485. <i>Steam power.</i> —William Avery, Syracuse, N. Y.	28
486. <i>Power loom.</i> —Benjamin Lapham, Waterford, N. Y.	28
487. <i>Cooking stoves.</i> —Sebastian H. Laciard, Macungy, Penn.	28
488. <i>Buildings, constructing.</i> —Lewis Knapp, N. Y.	28
489. <i>Feathers, dressing.</i> —Benton P. Coston, Philadelphia,	28
490. <i>Drawing knife.</i> —Edmund Richards, Hingham, Mass.	28
491. <i>Chair, easy.</i> —Andrew Wood, Charlestown, Va.	28
492. <i>Spoons, casting.</i> —William Mix, Prospect, Conn.	28
493. <i>Cooking stove.</i> —P. F. Perry, Rockingham, Vermont,	28
494. <i>Plane, revolving.</i> —Samuel Hedge, Brattleboro' Vermont,	28
495. <i>Clover seed, hulling.</i> —J. Hopper and A. Douty, Moresborough, Penn.	30
496. <i>Pottery, moulding.</i> —J. C. Mendell and R. B. Ricketts, Maysville, Ky.	30
497. <i>Mowing machine.</i> —John Drummond, Waterford, N. Y.	30
498. <i>Leather, glazed.</i> —E. G. Adams, Decatur, Georgia,	30
499. <i>Horse power.</i> —John Abbott, South Reading, Mass.	30
500. <i>Bitt-stock.</i> —Jeremy Taylor, Hebron, Conn.	30
501. <i>Stoves.</i> —James Atwater, New Haven, Conn.	30
502. <i>Saw mill.</i> —Simon Willard, N. Y.	30
503. <i>Cultivator.</i> —J. S. Eastman, Baltimore,	30
504. <i>Parlour stove.</i> —Beriah Douglass, Albany, N. Y.	30
505. <i>Cooking stove.</i> —Beriah Douglass, Albany, N. Y.	30
506. <i>Pump.</i> —Abraham T. Mixsell, Oxford, N. J.	30
507. <i>Over shoes.</i> —Daniel H. Bond, Canterbury, Conn.	30
508. <i>Hides, unhairing.</i> —James Banks, Dexmont, Maine,	30
509. <i>Bee hive.</i> —John M. Weeks, Salisbury, Vermont,	30
510. <i>Sawing staves.</i> —Chas. M. Keller, Washington, D. C.	30
511. <i>Crane.</i> —Gilbert Sherwood, Erie, Penn.	30
512. <i>Raising vessels.</i> —Tobias Cook, Scituate, Mass.	30

## CELESTIAL PHENOMENA, FOR NOVEMBER, 1836.

*Calculated by S. C. Walker.*

Day.	H <sup>r</sup> .	Min.					
2	17	28	Im	Leonis	,6,	N. 39°	V.358°
2	18	49	Em			258	240
21	8	52	Im	53 Arietis	,6,	173	130
21	9	44	Em			255	224
23	14	3	N. App.	and k Tauri	,6, ☾ North 3'.0		
26	16	52	Im	c Geminorum	,6,	13	64
26	17	35	Em			311	8
28	9	7	Im	Cancri	,6,	119	73
28	9	51	Em			225	176
29	12	1	Im	Leonis	,3.4,	77	24
29	13	1	Em			247	194

*Meteorological Observations for July, 1836.*

Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather and Remarks.
Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Direction.	Force.		
1 64°	86°	Inches 29.85	Inches 29.85	W.	Moderate.		
2 67	83	29.85	29.85	SW.	do.		Hazy—clear.
3 68	81	29.90	29.85	S. E.S.	do.		Fog—clear, sultry.
4 71	82	29.90	29.85	SW.	do.		Cloudy—flying clouds.
5 72	86	29.85	29.85	SW.	do.		Cloudy—clear.
6 70	82	29.86	29.86	W.	do.		Cloudy—clear.
7 70	82	29.90	29.83	W.	Brisk.		Lightly cloudy—clear.
8 70	83	29.83	29.84	W.	do.		Clear.
9 70	80	29.80	29.75	SW.	do.		Clear—lightly cloudy.
10 74	78	29.70	29.80	N. E.	do.		Clear—floating clouds.
11 66	80	29.85	29.90	N. E.	do.		Lightly cloudy.
12 68	76	29.90	29.90	N. E.	do.		Cloudy—lightly cloudy.
13 70	80	29.85	29.85	E.	do.		Cloudy—lightly cloudy.
14 70	82	29.80	29.84	E.	do.		Rain—Cloudy.
15 60	71	29.80	29.83	E.	do.		Cloudy—lightly cloudy.
16 64	74	29.94	29.96	N. E.	Brisk.	1.03	Rain—rain.
17 58	71	30.00	30.05	N.	do.		Clear—flying clouds.
18 58	74	30.30	30.30	N.	Moderate.		Clear day.
19 64	80	30.10	30.10	W.	do.		Clear day.
20 64	84	29.95	29.86	N.S.	Brisk.		Clear day.
21 67	81	29.70	29.65	SW.	Moderate.	.02	Lightly cloudy—rain in night.
22 69	81	29.54	29.54	S. E.	do.	1.05	Lightly cloudy, do
23 62	78	29.75	29.80	S. E.	do.		Clear—flying clouds.
24 64	78	29.80	29.83	SW.	Brisk.	.50	Cloudy, do. rain in night.
25 63	79	29.83	29.90	N.W.	Moderate.		Cloudy—flying clouds.
26 67	66	29.80	29.83	N.	do.	.60	Cloudy—rain.
27 62	73	29.95	29.95	S.E.S.	do.		Clear day.
28 66	75	29.90	29.90	S.E.S.	do.		Cloudy—lightly cloudy.
29 66	79	29.85	29.80	S.	Brisk.	.63	Cloudy—lightly cloudy.
30 70	80	29.65	29.65	W.	Moderate.		Drizzle—cloudy.
31 68	81	29.80	29.85	W.	do.		Clear day.
Mean	79.36	29.85	29.87			3.30	

Thermometer.

Maximum height during the month. 88, on 7th.

Minimum do. 58, on 17th &amp; 18th.

Mean do. 72.89

Barometer.

30.50 on 17th,

29.54 on 22nd,

29.86

**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**  
DEVOTED TO  
**Mechanical and Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

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NOVEMBER, 1836.

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**Practical and Theoretical Mechanics.**

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*Report of the Committee of the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, on the Explosions of Steam Boilers. PART II., containing the GENERAL REPORT of the Committee.*

(CONTINUED FROM p. 132.)

27. *First.* Unduly heated metal may result from a deficiency of water within a boiler. This seems to be a frequent and generally acknowledged source of explosion. The forcing-pump, by which a boiler is supplied with water, if at first well regulated, so as to furnish an adequate supply, and if kept constantly in action by the machinery, is subsequently liable to derangement of various kinds. The valves may be put out of order, the passages to or from the pump may be choked by sedimentary, or saline, matter. The pump may in some cases be heated so as to inject steam and not water. Any accident of this sort will cut off the due supply of water, and the level of that within the boiler will be lowered more or less rapidly. This will be true of self-acting, as well as of ordinary, means of supplying boilers. No one we believe has yet been applied, the working of which can, at all times, be relied on. There are, besides, cases in which the forcing-pump is not in action, when the production and use, or waste, of steam is going forward. In some stationary engines, the feeding of the boiler only goes on at inter-

vals, and the due supply is therefore dependant on the attention of the fireman. The same is true of steamboat boilers when the boat stops at a landing, and indeed the mischief is frequently increased by opening the safety-valve by hand, and allowing the steam, and of course the water, to waste freely. By an approximate calculation\* it may be seen that to lower the water one inch in a cylindrical boiler with an interior furnace, or in a boiler of the same form where the fire is applied directly to the exterior, and with an interior flue, will require but from five to nine minutes. If by this depression an interior flue of eighteen inches should be laid bare for an inch in depth, between 102 and 103 square inches of surface would be subjected to the action of the fire, for every foot in length of the flue, supposed level.

28. It thus appears that by accident, or in the ordinary management of the steam engine, a deficiency of water may occur, and highly heated metal be produced within a boiler. Recorded instances show that such has frequently been the case.†

29. The metal, then, being softened by heat, may give way to the ordinary working pressure of the steam. This will, of course, depend upon the amount of this pressure, and upon the temperature which the metal has reached. The frequent rupture of boilers near the usual water-line, and in a horizontal plane containing very various thicknesses of metal, would lead us to suspect that this is connected with undue heating, which if all circumstances were equal in the parts of a boiler, would take effect equally, at equal distances from the water-line. But the Committee have not before them any well established instance in which a boiler without interior flues has exploded merely by the ordinary pressure of the steam, when the boiler had been unduly heated. The case of the explosion of a cylindrical boiler, at the foundry of Mr. McQueen, in New York, may have been an exception to this remark, but the fact of the water having been very low, though rendered probable, is not entirely made out.‡ The

\* In the case of a cylindrical boiler with an interior furnace and flue, calling  $l$  the length of fire-surface,  $d$  the diameter of the furnace, and  $\pi$  the ratio of the circumference of a circle to its diameter,  $\pi l d$  = the extent of fire-surface. Then since in a boiler of this kind 1 sq. foot (144 sq. inches) of fire-surface can convert into steam .356 cub. inches of water, per second;  $\pi l d \times \frac{.356}{144}$  = the number of cubic inches of water vaporized per second. Again if we denote by  $x$ , the depression in the water level in one second,  $c$  the breadth of the water-line, and assume the length of the boiler to be equal to that of the interior cylinder,  $x c l$  will be an approximate value for the quantity of water vaporized. Equating the two values found, and cancelling  $l$ , we have  $\pi d \times \frac{.356}{144} = x c$ . The depth of water may be assumed at two-thirds the diameter of the exterior cylinder, which, calling  $D$  that diameter, gives  $c = .98 D$ , and  $\pi d \times \frac{.356}{144} = .98 x D$ . The ratio of  $d$  to  $D$  in a number of cases in practice varies from .4 to .6 and even .7; taking the lower limit or  $d = .4 D$ , we have  $.4 \pi D \times \frac{.356}{144} = .98 x D$ . Whence  $x = .003$  inches per second. Or to lower the level one inch would require 5 mins. 16 secs., supposing the water not to reach the interior flue.

For a cylinder with an interior flue, but where the fire is applied, externally, supposing the effective fire-surface to be half that of the boiler, the depression per second, will not be less than two-thousandths of an inch.

† As instances, may be taken, the boiler of the steamboat *Huntress*, No. VII. Replies, &c. of the *Western Engineer*, No. II, Replies, &c. *Legislator*, *Eagle*, and *Massachusetts*, No. XVII. Replies, &c. *Explosions at Pittsburg*, No. XII. Replies, &c. and *Jour. Frank. Inst.* vol. iii. p. 70.

‡ Thomas Ewbank "On the Explosion of Steam Boilers," *Jour. Frank. Inst.* vol. x. p. 3. That the pressure was unusually great, is satisfactorily shown; and with or without undue heating, was, no doubt, the cause of the explosion. In the case of the *Etna*,

copper boiler exploded in the experiments of the Committee, may be considered, however, as illustrating the possibility of such an occurrence.\* The explosions in boilers with interior flues, arising from these circumstances, have been found to affect those flues which "collapse," that is, are crushed, and rent, and are frequently separated from the boiler. The case of the accident on board the steamboat Patriot, which occurred near the mouth of the river Ohio, in 1828, distinctly illustrates this point.† It is stated that the engine was kept in motion after it was known that the water was below the flues; an act of temerity which was followed by the collapse of one of the flues.

30. It is highly probable, as will be seen hereafter, that water is thrown upon the hot metal, in cases where the engine has just been set in motion, or when the safety-valve has been opened, just prior to an explosion, and hence we are not warranted in adducing such cases here.

31. The following, is a well authenticated instance in which the pressure was not sufficient to produce explosion, or in which the metal was cooled by its change of figure, but when the danger was obviously imminent. It was that of the boiler of the steamboat Legislator,‡ of which an oval flue was flattened by exposure to the steam pressure, when known to be unduly heated. An explosion was avoided by the fire being put out, as soon as the deficiency of water was ascertained.

32. The Committee next proceed to consider the means which have been pointed out, by which, in the event of an undue heating of a boiler, water may obtain access to the heated metal.

*Various means by which water may be brought into contact with heated metal*, have been suggested. This may occur by the intentional or accidental removal of an obstruction, or by some other repair, to a forcing-pump,§ or by the injection of water by a hand-pump.|| When it is recollected that one cubic inch of water will produce six hundred and twenty-one cubic inches of steam of three atmospheres, or one hundred and eighty-nine inches of steam of eleven atmospheres, and that this steam is produced far more rapidly than in the usual action of the boiler, we are at no loss to understand that an ordinary safety-valve cannot give vent to it. The explosions on board of the steamboats Grampus, Constitution, &c., should serve as warnings against the introduction of water into a boiler under such circumstances, and the course taken by the engineer of the Legislator as an example to be followed. In this latter case there can be no doubt, from the circumstances stated by Mr. Lester,¶ that an explosion

the boiler was unduly heated, but, whether it gave way to the pressure, ascertained from the working of the engine, to be lower than usual, or whether water had access to the hot metal, is not known.

\* Report of the Committee on Explosions, Part I. p. 68. Jour. Frank. Inst. vol. xvii. p. 225.

† Replies to Circular, &c. No. XXI. Thomas J. Haldermann, Esq. The explosion on board the Tricolour might be cited as another example. The boat was at rest. No. XXI. Replies, &c.

‡ Replies to Circular, No. XVII. E. A. Lester, Esq. of Boston.

§ In the case of the boilers of the Car of Commerce, (No. VII. Replies, &c.) of the Grampus, (No. XII. Replies, &c.,) &c.

|| See explosion of a boiler at Aston Forge, (No. XI. of Replies, &c.): Boiler of the steamboat Constitution, (No. VIII. of Replies, &c.,) &c.

¶ See Replies to Circular of Com. on Explosions, No. XVII. Letter of E. A. Lester Esq., to Sec. of Treasury.

was prevented by cooling the boilers previous to the introduction of water, when the deficiency was discovered. No circumstance of mere convenience, should be suffered to interfere with such a course.

33. A second means assigned for bringing water in contact with unduly heated metal in a boiler, is by the foaming produced by the opening of a safety-valve, or in the ordinary working of the engine. This foaming has been abundantly demonstrated, and a detailed statement of the direct experiments made on the subject by this Committee, may be seen in their report to the Secretary of the Treasury of the United States.\* Since the foaming is caused by making an opening in the boiler, it may be supposed that it cannot be adequate to do more than to produce steam to supply the place of that which escapes. This view of the subject derives some support from the experiments incidentally made by M. Arago,† and directly with this object by the Committee, but is contradicted by those of M. M. Tabareau and Rey.‡ In the experiments of M. Arago, the boilers were not unduly heated; in those of the Committee, there was present a considerable amount of heated metal, and in those last referred to, and in which an increase in the elasticity of the steam was produced by opening a safety-valve upon a small boiler, the boiler was surrounded by a charcoal fire. There can be little doubt, then, that the result must depend upon the precise circumstances of the case, and that danger *may* result, though it does not *necessarily* follow, from making an opening in the boiler when the water is low. This effect from foaming would be increased, if in addition to the agitation produced by the first working of the engine, after stopping, the safety-valve should be opened. This was the common practice on the Hudson, a few years since; the safety-valve being opened, by hand, on putting the boat in motion after the landing or taking up of passengers.

34. The successive explosions of connected boilers such as occurred at the Polgooth§ mines, and on board the steamboat Rhone,|| are easily explained if referred to the effect of foaming, and difficult to understand on any other principle, since just before the explosion of the second boiler a large opening was made for the escape of steam.¶

35. It has been assumed by our countryman Perkins, in his hypothesis on the subject of the explosion of steam boilers, that the hot steam formed by contact with unduly heated metal is the true source of danger. This opinion has been shown to be inconsistent with the deductions from sound theory.\*\* The injection of water into hot and unsaturated steam, should

\* Reply to query first. "To ascertain, by direct experiment, whether on relieving water heated to, or above, the boiling point, from pressure, any commotion is produced in the fluid." See also a paper by Mr. F. Peale, whose observations were contemporaneous with experiments of the Com. Jour. Frank. Inst., vol. viii. p. 145, and Replies, &c. No. XXI. Potts on Explosions, Jour. Frank. Inst., vol. vi. p. 327.

† M. Arago. Sur les explosions, &c. Annuaire du Bureau des Long., 1830, pp. 148, and 180, and Jour. Frank. Inst., vol. v. p. 404, and vol. vi. p. 47.

‡ Ibid.

§ J. Taylor, Esq. "On the accidents incident to Steam Boilers." Lond. Philos. Mag. vol. i., 1827.

|| Annuaire du Bureau des Long., 1830, and Jour. Frank. vol. v. p. 401.

¶ The same opinion is expressed by M. Arago, Annuaire, &c. p. 184. Translated in Jour. Frank. Inst., vol. vi., p. 49. The other cases referred to by him, in which an explosion followed the opening of a stop-cock by hand, as at Lyons, or of a safety-valve by the steam, as at Essone, may be explained by supposing the openings insufficient to give vent to the steam, which was produced by the action of the boiler, in the circumstances then existing.

\*\*Dulong. Annales de Chim. et de Phys. vol. xlviii.

reduce, not increase, its elasticity. With a view to ascertain if any circumstances had been omitted in the application of theory to this problem, the Committee made direct experiments on the subject. The water was introduced both in a full stream, and through small apertures. In no case, an increase, and in all but one a perceptible decrease, of elasticity in the hot and unsaturated steam, was observed. Fourteen ounces of water, injected into steam at  $533^{\circ}$  reduced its pressure .34 of an atmosphere.\* The steam had in this experiment a temperature corresponding to the pressure of sixty atmospheres,† and an actual elasticity of only 6.82 atmospheres. There was besides a fire which supplied heat, as it was absorbed by the vaporization of the injected water.

36. A correspondent has suggested‡ that when a steamboat is first set in motion, the inertia of the water may cause it to rise at one end of the boiler and then to oscillate, by which it would be thrown upon parts of the boiler which might be unduly heated. This is no doubt a true cause, but it would be difficult to say to what extent it would be effective. The subsequent suggestion that water can take a charge of heat in a latent state, which may be rendered free by mechanical means, the Committee do not conceive to be valid. Experiments which have been referred to as showing this, are fully explicable upon well established principles.

37. There are two other important circumstances to be examined falling under this division of the subject, namely, the effect of the careening of a boat, especially one having connected boilers, and the effects of the sudden cracking of deposits of mud or sediment, beneath which the metal is unduly heated. These will, however, be treated under separate heads.

38. The Committee now proceed to examine *the means proposed for preventing the occurrence of the dangerous circumstances now under discussion*. These of course have reference, mainly, to the original source of the danger, that is to the deficiency of water within the boiler, though an avoidance of the secondary causes might prove effectual.

39. First.—Various self-regulating apparatus for the supply of boilers have been proposed and partially used. Second.—Methods for ascertaining the level of the water or of giving notice when it falls to a certain level, are in use, or have been suggested. Third.—Some methods for ascertaining the temperature of the boiler, or of particular parts of it, have been contrived.

40. 1st. One of the most common methods of regulating the supply of water to a boiler is by the use of the float. This is understood to have been entirely successful in the low pressure boiler, the float being applied to raise a valve connecting a reservoir of water with the boiler to be supplied. A self-feeding apparatus in which a float was used was proposed by Mr. Charles Potts,§ who exhibited to the Franklin Institute a very neat working model, in which a glass boiler was kept at nearly a constant level by this

\* In a certain theoretical case, namely, that in which all the heat to vaporize the injected water, is derived, from the hot steam, and the quantity of water which that steam can vaporize, without reduction of temperature below that of saturated vapour of the same elasticity, is injected, the precise reduction of elasticity has been calculated by M. Dulong. See *Ann. de Chim. et de Phys.*, vol. xlviii, p. 378.

† Calculated from the formula deduced by M. M. Arago and Dulong from their experiments.

‡ Replies to Circular of Com. on Explosions, No. XX.

§ Journal of the Franklin Institute, vol. vi. p. 42, and also p. 327, &c., where the apparatus is illustrated by a figure.

method. Its application is most difficult in the case of a small high pressure boiler with interior flues.

Engineers differ very much in the amount of confidence which is to be placed in the float: those who have seen it in operation in the large boiler of a low pressure engine give it implicit confidence, others who have tried it in the small high pressure boiler consider its action too uncertain to answer a good purpose,\* even when in its best form. If the objections to the float are not valid, and we apprehend that they are only partially so, the real difficulty will be found to lie in general objections to all self-regulating apparatus. This obviously is one which is liable to get out of order since it communicates between the exterior and interior of a boiler, and hence must have a packed joint, liable when the stem is not in constant motion to become tight, and therefore beyond the power of the change of buoyancy in the float to move.

41. A most ingenious method of feeding boilers was patented in 1825, by Mr. Eve.† It consisted of a revolving cock, bored in part through, and playing alternately into the boiler, and into a box of water. It was expected that this cock being placed at a proper level of the water within a boiler, would merely draw out and return water while this was at a due height, but when it sunk too low would draw out steam and return water. The difficulty of condensing the high steam‡ drawn out, and of making the returned water flow out of the openings, seems to have rendered this, as well as other promising schemes of the same sort, abortive.§ An attempt to obviate these objections which was seen by some of the members of this Committee was unsuccessful. Mr. Charles Potts|| has recently proposed a plan which is similar in principle. It will have to encounter the difficulty of the flow of water from moderately large openings when the pressure on the two ends of the column is the same, and the necessity for the alternate heating and cooling of the revolving plug or chamber which acts as a feeder, and of at least a part of its contents. They agree entirely, however, with the Committee on Science and the Arts that this principle merits further trial.¶

42. The Committee are decidedly of opinion that no self-feeding apparatus has been, or is likely to be, invented which can be a substitute for the care of an engineer; and, indeed, they consider the carelessness which is liable to result from their use as a very serious, though not an insuperable, objection to them.

43. 2nd. Methods for ascertaining the level of the water in a boiler, or of giving notice when it falls to a certain level.

The imperfection of the gauge-cocks in ordinary use has been often pointed out, and indeed is generally admitted. Originating in the very infancy

\* D. J. Burr on the explosion of steam boilers. *Jour. Frank. Inst.*, vol. vi. p. 335. Mr. Redfield objects to its use in steamboat boilers, see Report to Secy. Tres. U. S. in Doc. H. R., No. 478, session 1831—2.

† *Lond. Jour. of Arts*, vol. xii. p. 230., *Lond. Mechs. Mag.* vol. vii. p. 344, *Rep. Pat. Invent.* vol. iii. p. 70. A revolving wheel for the same purpose has been patented by Mr. Jesse Fox. *Jour. Frank. Inst.* vol. x. p. 161.

‡ See also J. S. Williams' patent for supplying boilers with water. *Jour. Frank. Inst.* vol. vii. p. 183, which though different in action is liable to this objection, in even greater force.

§ Walker's feeding plug. *Trans. Soc. Arts, &c.*, vol. L. part i. p. 63. Sliding valve and box. *Lond. Mechs. Mag.* vol. xxi. p. 376.

|| *Journal of the Franklin Institute*, May, 1836, vol. xvii. p. 302.

¶ Report on a "Plan of a new pump for feeding steam boilers." *Jour. Frank. Inst.* vol. xviii, p. 3. 1836.

of the art in Savery's engine, they remain at this day, a stain upon its more mature age. At best,\* when the water is tranquil within a boiler, they only show, roughly, the position of the water line; and when it is above the highest cock, or below the lowest, they fail entirely; and cannot be placed far apart without making their indications, within these limits, too rude even for practice. When a boiler is in action, particularly if it is small and contains high pressure steam, the foaming is so considerable as to interfere with their use. In the report of experiments by this Committee, abundant evidence is to be found of this imperfection; as an example of which may be taken the case, where by raising the safety-valve, of the small experimental boiler, indications of water appeared at a gauge-cock, below which the hydrostatic level was known to be nearly two inches.†

44. The method of indicating the level of the water by a float‡ is liable to all the objections urged against the feeding apparatus, depending for its action upon that instrument. It has not, however, except in very rare cases, been used in this country. An alarm float was tried by the Committee, which is not subject to the objection in regard to the stuffing-box, since it is entirely within the boiler. This is by no means a new device,§ though the particular arrangement was made by Mr. D. H. Mason for the Committee; and is figured and described in the first part of their report.|| This device is intended to allow the escape of a small jet of steam whenever the water rises above, or falls below, a determinate level.¶ The alarm by the issue of steam through a trumpet tube, being only applicable to engines working at very low pressures, does not require special notice here.

45. With due care on the part of the Engineer, and the Committee are of opinion that no substitute has yet been found for such care, the glass tube affords the best means known to us, for observing the level of the water within a boiler. It seems strange that this excellent device which has stood the test both of experiment and of practice, has met with so limited a degree of favour. In the great progress made of late years, in the locomotive engine, it has been so clearly shown that engineers and their assistants can be induced to employ any machinery, the use of which is insisted upon, that the excuse of their indisposition to change should not be urged any longer. In this very case, in which the glass tube, is probably more exposed to fracture, than in any other, it is practically used. The objection on the score of its breaking by unequal expansion and contraction

\* From the remarks which follow, exclusive of the objection on the score of the effect of foaming, we must except the shifting gauge-cock of Mr. Philos. Tyler described in Jour. Frank. Inst., vol. xv. p. 178.

† Report of Com. on Explosions, Part I. pp. 11, 12, &c. Jour. Frank. Inst., vol. xvii. pp. 9, 10. Peale on the height of water in boilers of locomotives, Jour. Frank. Inst., vol. viii. and Replies No. XXI. Potts on explosions. Jour. Frank. Inst. vol. vi. p. 329.

‡ The hydrostat described in No. XXX. of replies is inadmissible, from the interior of the boiler being occupied by a second cylinder leaving only an annular space for the production of steam. For the alarm floats of J. L. Sullivan, Esq., see Silliman's Journal, vol. xx. p. 1.

§ See the alarm float of Siebe. Lond. Jour. of Arts, vol. xiii. p. 273. The first of those known to the Committee.

|| Report p. 14, 15, Plate 4, Fig. A. Jour. Frank. Inst. vol. xvii. pp. 13, 14.

¶ It is exposed to a slight objection from steam pressure acting to keep the disks upon the openings, these latter are, however, quite small, and the pressing surfaces of the disks may be regulated accordingly.

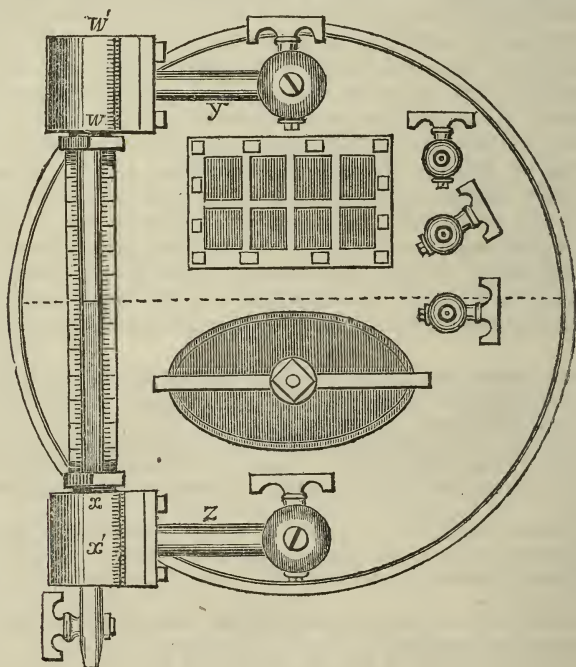
The float described by Mr. Ewbank, Jour. Frank. Inst. vol. x. p. 7, is also referred to by the Committee as deserving a full trial.

of the glass, and of the metal with which it is connected, has been obviated, by passing the ends of the tube into stuffing boxes; that on the score of its breaking by shocks, by giving it great thickness; and that of its breaking by sudden variations of temperature by using well annealed glass. The difficulty of the glass clouding when high steam is used, by the action of the steam on the alkali, is got rid of by using green glass. The experiments which the Committee made on this apparatus, were highly satisfactory and they confidently recommend its use to practical men.\*

46. 3rd. The danger resulting from a deficient supply of water, being produced by the undue heating of parts of a boiler, many means have been proposed for showing such an increase of temperature, before it attains a dangerous degree. The fusible plates applied to the top of the boiler may be intended to indicate the general temperature of the steam when saturated with moisture or not, or the local temperature resulting from the rising of hot and unsaturated steam, produced by unduly heated metal.

\* The following description of the tube water gauge used by the Committee is taken from the first part of their report, p. 12, &c. (Jour. Frank. Inst. vol. xvii. p. 10).

"The tube gauge is shown in the annexed figure.  $w x$  is a tube of green glass passing into the stuffing boxes,  $w' x'$ ; the stuffing enables an adjustment to be made for the unequal expansion of the glass and metal by heat, and prevents fracture on the subsequent cooling of the apparatus.  $y$  and  $z$ , are pipes connecting the tube with the boiler; these have conical terminations, by which the pipes are readily attached to, and detached from, the tubes connecting them with the boiler, which are provided with



stop-cocks: coupling screws might, in practice, be substituted for these conical terminations. To protect the tube,  $w x$ , from currents of air, it was surrounded by a second tube, loosely applied. A scale was attached to  $w x$ , to indicate the level of the water within the boiler.

In any case they will be exposed to pressure; though to less in the second case than in the first. The objections already urged, and derived from experiment, will apply to their use, in the ordinary way, in any one of these cases. Indeed without this objection, it appears that as the source of danger is the heated metal, to this the indicator of temperature should be applied.

47. Various methods of indicating the temperature of a part, or parts, of a boiler have been contrived. One of the most simple is to apply the common thermometer, inserting the bulb and as much of the stem as is necessary, in a tube closed at one end and fastened into the boiler. The tube should contain mercury, through which the heat is conducted to the thermometer. Such a tube may be placed at, or near, the water line of a boiler, at the fire end of a flue, or in general at the place of greatest exposure to heat from a deficiency of water, of which there will usually be one or more well determined, according to the form of the boiler. A mark upon the scale of the thermometer will show the temperature above which the metal must not be allowed to rise, either from an increased elastic force in the steam, or from a deficient supply of water. The fragility of the instrument, its inconvenient length, or position in certain cases, and its not acting as an alarm, are the principal objections to its use.\*

48. The expanding rods proposed by Mr. Cadwallader Evans are ingenious; they give, however, not the local temperature of the boiler, but its general temperature, along the lines to which the rods are applied. A much more appropriate device, is the application of fusible metal proposed by the same gentleman.† This is intended to take the place of the ordinary fusible plate, and to avoid the difficulty, originally existing, but since remedied‡, of replacing the plate when it had fused. In the apparatus submitted to the Committee§ by their chairman, and subsequently made the object of experiment, the fusible metal is applied to the most exposed part of a boiler: it is so small in quantity, that it will serve to indicate a local temperature, while the motion which indicates its fusion is independent of the quantity of fusible metal. These instruments are intended, respectively to give notice when the steam, or the metal of the boiler is exposed to a temperature much below that which would produce danger. Both of them, after giving an alarm, can be immediately restored to action if the temperature within has been made to decrease.¶

\* For a detailed description of the mode of applying the thermometer see the report of Com. on Expl. Part. I. pages 7 and 8, and Jour. Frank. Inst. vol. xvii. pp. 5, 6.

† Communication to Com. on Explosion, No. XXII. of Replies, &c. Jour. Frank. Inst. vol. ix. February, 1832. Patented in May, 1834. See specification in Jour. Frank. Inst. vol. xiv. p. 391. The Committee prefer this to the apparatus acting by the expansion of mercury.

‡ Hall's method of applying the fusible plate. Bulletin de la Soc. d'Encouragement, &c.

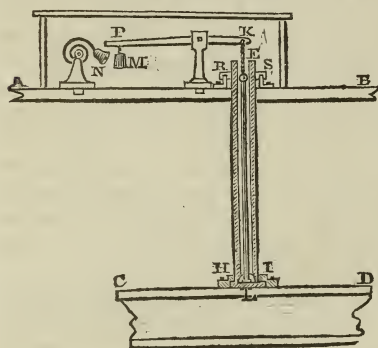
§ Described in Jour. Frank. Inst. vol. x. p. 217.

¶ The apparatus devised by the Chairman of this Committee, was made the subject of experiments, and, with them, is thus described in Part I. of the Report of Com. on Expl. It is obviously as applicable to a common boiler, as to one with interior flues.

"A tube of iron, or copper," according to the material of the boiler, "closed at the lower end, passes through the top of the boiler, its closed end reaching the flue to which it is attached." "This tube, it will be observed, affords a ready access to the flue, to ascertain its temperature, without any restraint from packing." "A mass of fusible metal placed at the bottom of the tube," "will become fluid very nearly as soon as the flue takes the temperature of the fusion of the alloy." "To show when the metal at the bottom of the tube becomes fluid, a stem is attached with a cord and

By very simple changes in the apparatus, the fusible metal might be applied to the boilers of locomotive engines.

weight," "or with a lever and weight." "The weight and longer arm of the lever, descending, may be made to ring a bell, or, by appropriate attachments, to turn a cock, permitting just enough steam to issue to give the alarm, and then to be closed at once. A projection on the lower end of the rod prevents it from being drawn from the metal until this latter is fused, and by widening the lower part of the tube, making it slightly tapering, the metal is kept from being drawn out by the rod."



In the annexed figure "AB is a section through the top of the boiler; CD, a corresponding section of its flue; EH represents a tube closed at the lower end, which is attached to the upper side of the flue. The mode of attachment by a projection on the tube and a ring screwed to the flue, is shown in the figure, as also the stuffing box RS, through which the upper end of the tube passes. The lower part HI, of the tube, is made tapering, to retain the fusible metal. KL is the stem, the lower part being inclosed by the fusible metal, the upper part attached by a chain to a lever KP. The weight M, draws the rod KL upwards, and on the fusion of the alloy HI carries the lever below the bell N, which being attached to a spring, rings an alarm."

The form of this apparatus, which was subjected to trial by the Committee, was essentially the same with that described. One of the tubes in which the thermometers were ordinarily placed, was used to contain the fusible metal, and as giving the more severe test, the short one entering only into the steam, was selected. For the convenience of removing the metal, it was placed in a metallic case, fitting loosely into the iron tube, and having a wire attached, by which it could be drawn out of the tube. This certainly diminished the sensibility of the apparatus, particularly, as the case was quite as thick as the enclosing tube, and as there was a small space between its convex surface and that of the tube; it was required, however, for the convenience of the experiments.

The results of the several trials are contained in the following table. The temperature was registered by the adjoining thermometer dipping into the water of the boiler, and already often referred to; it was raised as rapidly as possible in all the experiments except the first. The first four trials were made on an occasion specially devoted to this purpose, the last two were made incidentally when upon another subject.

Number of trial.	Temperature. Fah.°	REMARKS.
1	268	Stem rises. No particular attention paid to raising the temperature rapidly.
2	270	Stem rises. Steam raised rapidly.
3	274	Metal drawn out and suffered to cool, re-deposited cold in tube. Steam at 258°, and raised to 274° in 2½ minutes.
4	274	Stem rises. Metal drawn out and cooled. Steam at 250°, when metal was replaced. Steam rises at 274° in 3 minutes.
	274	Stem rises.
	252	Metal had become solid again. Steam let off rapidly.
5	270	Melted below this temperature.
6	256	Stem rises. Metal remains in a soft solid, so that the stem can be drawn out, until 240°.

A fact noticed during the experiments on fusible alloys was again verified in these;

49. *Second.*—*The undue heating of parts of a boiler may be produced by deposits.*

No cause of undue heating is better made out than this one, and the remedy is of the most simple kind.

The water of all rivers contains, in suspension, in greater or less quantities, the muddy particles detached from their banks or beds, and may contain in solution, salts derived from the same sources, or from the springs which supply the stream. The water of springs generally contains so large an impregnation of saline matter, as to decompose soap. The rivers of our Atlantic States, where perfectly fresh, contain few dissolved impurities, while many of those of the Western States are highly charged with calcareous matter. When waters holding substances in suspension, or solution, are evaporated, a sediment is deposited, varying in nature with the water employed. As the quantity of solid matter contained in the water varies, so the time required for such a deposit to take place, from the feeding water of a steam boiler, must be very variable. If a deposit is allowed to remain in a boiler, it gradually increases in thickness and in density; the heat which before passed rapidly from the metal to the water, is now impeded by a mass of viscid or of solid matter, which is a bad circulator or conductor of heat, and the temperature of the metal rises. The sediment thus heated increases in denseness, and may even form a hard crust upon the bottom of the boiler. A complete non-conducting coat is thus formed, which, if from its nature liable to crack or fissure, may allow water to have access to the heated metal below, and produce an explosion. This supposition is, however, as will be seen, by no means necessary to such a result. The most usual action of the sediment would seem to be as follows. When it has accumulated in thickness, sufficiently to produce a temperature in the metal, at which its strength is inadequate to bear the pressure without extending, it yields, and becoming more and more attenuated, finally bursts. It seems that the first yielding may bring water in contact with the metal so as to cool it, when the steam produced is not sufficient materially to increase the pressure within the boiler. Thus the attenuation may increase for a considerable time and gradually, and at last the bursting not produce any more injurious effect than to stop the working of the engine.

Accidental circumstances of figure, heat, &c., seem frequently to determine the places of deposit of these masses of sediment, but it is principally observed at the fire-end of the boiler, where its presence is most dangerous.

namely, that the mixtures of metals require a considerable time to change their state of solidity, or of fluidity, so that in the former case they may be raised, if heated rapidly, above the true temperature of fluidity, and in the latter case they may be cooled much below this temperature, without solidifying. The alloy used in these experiments appears to have put the apparatus very fully upon its trial in this respect, and the experiments were performed so rapidly as to give a further severe test. On the occasion devoted to the trials when the steam was not urged up with its greatest rapidity, the stem was drawn out at 268° when more rapidly at 270°, and with the fire at its maximum intensity, when the water was raised in temperature 24° in three minutes, the stem was drawn out at 274°. In other experiments it gave way at 256°. The range is 18° Fah. corresponding at ten atmospheres, to less than two atmospheres, under the test of very severe comparisons. There appears no reason to doubt, that when tested by no more rigid modes than practice would furnish, this apparatus would not only apply as an alarm to prevent undue heating of the parts of the boiler, but as a manageable, and useful check, in ordinary cases, upon the safety-valve. Report &c. Part I. and Jour. Frank. Inst. vol. xvii. p. 85.

50. The Committee have derived much information of a practical kind on this subject, and coming as it does from entirely different quarters of the country, where the water depositing the sediment was of different qualities, the details agree very remarkably.

Col. S. H. Long\* describes a deposit found in one of the boilers of the Western Engineer, a boat used in the exploring expedition of 1818. The sediment had collected in less than two days so as to be two inches thick, and was found in parts of the boiler, where, from its construction, the heat was greatest. A difficulty in making steam enough for the supply of the engine, was observed, and induced an examination of the boilers, in one of which, the metal at a particular spot was found to have been made to project an inch and a half. In this case timely precaution prevented further evil consequences.

51. The plan of "blowing off" the lower parts of the fluid in a boiler, which is very generally used in turbid streams to the West, is, no doubt, of considerable service while the boat is running, but should never be used as a substitute for cleaning the boilers, when opportunity is afforded for this complete operation. Indeed it must be carefully executed, since if the flues are bared by it, any deposit upon them may become hardened before the boiler is replenished with water.

52. A practical engineer of New Albany, Indiana, Mr. Benton,† states that he has found deposits in boilers, used on our western waters, "almost as hard as the iron itself." These consist of a mixture of calcareous matter with the ordinary mud of the rivers.

The very consistent and satisfactory accounts given of the explosion of a boiler of the steamboat Caledonia, on the Mississippi, show that the disaster had its origin, at least in part, in the deposit within the boiler. The boat had eight connected cylinder boilers of wrought iron, for high steam, thirty inches in diameter and twenty feet long, with interior flues. The engine had been in operation for seven consecutive days, prior to the accident, and had, just before its occurrence, been stopped for about eight hours, to repair the machinery. During the time of stopping, the boilers were not blown out, and two hours after resuming the working of the engine the explosion occurred. On subsequent examination, it was found to have occurred in a patch, which had been put on the year before with copper rivets; the sediment on the bottom of the boiler was found to have been heated, so as to render it very hard. The rent began at about one-third of the diameter of the boiler from the bottom, that is, at, or near, the fire line, and passed upwards. The sediment had caused the heating of the copper rivets, and, it is probable, that the working pressure of the steam accomplished the rest.

53. The effect of a deposit of a different kind, in a boiler, near Richmond, Virginia, is well described by Mr. Burr.‡ The boiler was of wrought-iron, five-sixteenths of an inch thick; the water used for its supply was a chalybeate, but not so strong as to prevent its common use, as a beverage, by the workmen. A few weeks after the engine had been put in operation, a crack was observed in the boiler, just over the fire, and on examination, a deposit of oxide of iron was found in this place. The fire-end is stated to have been lowest in the setting of the boiler. A plate of wrought iron was substituted for that which had cracked. In four or five weeks a swelling began to form upon this plate, which continued to

\* Replies to Circular of Com. on Expl. No. II.

† Reply to Circular of Com. on Expl., by Erasmus W. Benton, No. VIII.

‡ Jour. Frank. Inst., vol. vi. p. 334.

increase until it attained a considerable size, and in ten days from the first on which the protuberance had been observed, the boiler burst. No great damage was done. The iron was found to have been diminished in thickness, at the spot where the rent occurred, to one-eighth of an inch.

54. The deposits in boilers using salt water are no less dangerous. Mr. Lester\* gives an account of the case of the boilers in the steamboat *Eagle*, of Boston, which leaked after being in use two or three weeks, and on examination were found to contain a deposit of from two to three inches thick, and which, in some parts, was so hard as to require the use of a hammer and chisel to remove it.†

55. Various other cases are on record of the effects of deposits in boilers, but the characteristic ones which have been selected convey all the information necessary. They show that no rule as to the time of cleansing a boiler can be general, and fully enforce the necessity for care upon this point. Farinaceous substances introduced into a boiler may tend to render frequent cleansing less necessary in cases of sedimentary matter, but cannot dispense with it.‡ Sound economy, as well as safety, require frequent cleansing of a boiler using hard or muddy water. The least that can happen, after the accumulation of sediment, is the injury of the boiler, perhaps its bursting, and a true explosion may result. Two violent explosions, at Bowen's mill,§ and at McMickle's mill in Pittsburgh, are fairly attributable to the effect of sediment, and there does not appear, in either case, to have been a deficiency of water at the time of the explosion.

56. The accidental introduction of materials which are bad conductors of heat within a boiler, may produce the same effect as the deposits just described. Mr. Benton|| suggests that loose packing from the steam cylinder is sometimes passed through the force-pump and collecting under the flues, causes them to be highly heated. M. Arago mentions an instance of a rent made in a boiler, at Paris,¶ by the accidental resting of a rag on the bottom of the boiler.

57. Frequent cleansing of the boiler, or blowing out the lowest portions by small quantities at a time, are the true preventives to accidents from deposits. Besides them, however, the use of chemical reagents has been proposed for limestone water, and filtering in the case of muddy water.

\* Letter to Sec. Treas. U. S. Replies to Com. on Expl., No. XVII. See also Jour. Frank. Inst., vol. vii. p. 289, &c.

† In a letter to the editor of the Jour. Frank. Inst., a gentleman of Boston, states that in a boiler using salt water, a deposit of more than two inches in thickness occurred in less than twenty days. Mr. West states that deposits, chiefly of sulphate of lime, occur in from one to six weeks of use, in the boilers at Manchester. See Jour. Royal Institution, vol. i. p. 42. See also F. Naested's letter to Sec. Treas. U. S., Doc. H. Rep. U. S., 1832-3, No. 478, p. 52.

‡ It was stated on the authority of Sig. Ferrari, that coarse charcoal prevents or removes deposits in boilers. (Jour. Frank. Inst. vol. ix. p. 420.) The Society of Arts of London awarded in 1833, a premium to Mr. Jas. Bedford for rendering deposits readily removeable by introducing sperm oil into the boiler. We are not aware to what extent this device has been tried. (Trans. Soc. Arts. vol. xlix. Part II. p. 83.) The use of grease for the same purpose is recommended in the Lond. Mechs. Mag. vol. vi. p. 308, and in the same Journal (Vol. ii. p. 206.) it is stated that the radicles of barley produced in the process of malting prevent deposits. These act on the same principle as the fecula of potatoes. They merely retard the formation of a deposit, and by rendering the fluid viscid, no doubt ultimately affect the generation of steam.

§ Replies to Circular, &c. No. XII. Letter of Thos. W. Bakewell, Esq. to Sec. Treas. U. S.

|| Replies, &c. No. VIII.

¶ Used in producing steam to heat the exchange.

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The former of these would prove but a partial remedy, and in unskilful hands would be dangerous, and the latter would probably be objected to on the score of its considerable expense. When the escape steam is allowed to run to waste this would be especially the case.

58. It has been also proposed to use boxes for collecting the sediment, but from them the Committee would not anticipate any very good result, though they might, in part, facilitate the cleansing of a boiler.

59. *Third.*—*The careening of a steamboat may expose parts of the boiler to heat without their being covered by water, and a subsequent return to its level will bring water in contact with the heated metal.*

There is no evidence known to the Committee that the careening of a boat has ever produced accident in any other than the small connected cylinder boilers, so extensively used in the boats navigating the western waters. In these, the danger has been forcibly pointed out by several correspondents,\* and means of remedying it suggested.† These boilers communicate by pipes below the ordinary water level, and are supplied by the same forcing-pump. The fire is most generally applied to the exterior of the boilers, and they have besides interior flues. Being placed side by side, the length of the boiler being parallel to the keel of the boat, they occupy according to their size and number a more or less considerable portion of its breadth. The six contiguous boilers of the steamboat Helen McGregor, and the eight of the Caledonia occupied certainly not less than twenty-two feet in breadth of the boat. Calculating upon the dimensions of the boilers in the first named boat, and taking into view the circumstances under which the water has access to the heated metal, we find that a depression of nine inches, at the extreme boiler, taking place about the axis of the set of boilers, would expose a surface of boiler and flue together competent to supply, when the water returned upon them, one-third more steam than the ordinary working of the boiler could furnish: this supply being kept up, at an average, during the cooling of the elevated boilers to their ordinary working temperature. This danger might easily be met by an increased area of safety-valve, if indeed those commonly used would be insufficient, for the escape of the extra steam.‡ But the danger from even the working pressure acting upon the metal, of which the tenacity has been much decreased, is the real source of danger, and is not thus to be parried. There are but about 440 degrees of Fahrenheit's scale between the working pressure of eleven atmospheres, and a red heat visible in the dark.

This careening of the boat is liable to occur at every landing place and to last for a considerable time. Whenever a passing boat, an engaging view, or accident, shall call the passengers to one side of the boat it will be thrown out of trim.

60. In the small boats on our Atlantic rivers there are heavy carriages used to keep the deck level; these are also used in the English steam-packets which carry sails, but the Committee are not aware that they are employed in the boats of our western waters.

\* The first communication made to the Committee on this subject was by James J. Rush, Esq. of the firm of Rush and Muhlenberg; by some accident the drawings presented by him were not deposited among the papers of the Committee, and a similar diagram to that of Mr. Rush being afterwards presented by Mr. C. Evans was published among the Replies to the Circular of the Com., No. XXII.

† Replies to Circular, &c. No. XXII. Earle on Explosions, Jour. Frank. Inst. vol. vii. p. 154.

‡ We are not able to make the calculation corresponding to this remark, not having the dimensions of the safety-valve, or valves, of the boilers of any one of the western Boats.

61. *Different modes of remedying the evil under discussion, and to be applied to the boilers themselves have been suggested.*

The first of these which came before the Committee, and which we believe has been applied in practice, was by Mr. James J. Rush. Doors are placed in the flues, at a point furthest from the fire-end, which, when opened, check the draught through the furnace and flues, and consequently prevent their becoming unduly heated. These are to be thrown open at each landing place. They do not, however, meet the case of accidental careening of the boat, unless made self-acting by expanding rods, as was proposed by Mr. Rush. They expose the flues to the action of air containing its full supply of oxygen, and must tend therefore to oxidize them more rapidly than in the ordinary wear of the engine.

62. The other devices before the Committee are those of Mr. C. Evans,\* and of Mr. J. S. Williams.† The first places the mouth of the feeding-pipe just below the proper level of the water in the boiler, so that it shall be laid bare by a change of level, and the water be prevented from escaping from the higher boilers. This would remedy the evil, except in cases where the careening was sufficiently long continued to exhaust the upper boilers of water by the ordinary working of the engine; those boilers of which the supply pipes are bare not being likely to receive any supply from the pump. Mr. Williams places the supply pipes below the boilers and feeds through valves opening upwards, which of course prevent any return of water. The valves in this machine and also those proposed by Mr. Evans, to prevent any escape of water from the higher boilers, would be objectionable. The method of cleansing the pipes proposed by Mr. Evans is very ingenious.

63. After a careful examination of these devices, the Committee are of opinion that they present but partial remedies for the evils which they are intended to meet, and they consider that nothing less than detaching these boilers from each other, and feeding them singly, or at most in pairs, will prove effectual. They would therefore, respectfully, but earnestly, urge this upon constructors and owners.

64. *Fourth. Are there cases in which the metal of a boiler may become unduly heated when in contact with water?*

After much reflection and examination the Committee are of opinion that such cases *may* occur. They believe that such have occurred, though not frequently, and that with the common thicknesses of iron and copper boilers, and modes of arranging the furnaces, there is very little liability of their occurrence. Still it is well to recognise that such may be the case, as it may prevent accident by watchfulness in the use of a new construction of boiler, or application of the fire.

65. Mr. F. Graff‡ mentions specially an instance "in which the heads of the bolts burning off over the fire-place, and the joints parting;" "the boiling water passed into the ash pit." From his known carefulness, there is no reason to suspect that there was sediment in this boiler, which was one of the low pressure boilers used at the Philadelphia water-works.

66. Mr. Hebert§ gives two cases, in the first three different rents of an

\* Replies to Circular, &c. No. XXII.

† Jour. Frank. Inst. vol. viii. p. 289. The method adopted by Mr. W. C. Redfield, places the means of feeding separately, or in the connected way, within the control of the engineer. This was not presented to the Committee, but may be found alluded to in the Documents of the House of Representatives of the United States, 1832-3, No. 478, p. 17.

‡ Letter to Councils. Replies to Circular, &c., 4th of No. I.

§ Replies, &c. No. XI.

iron boiler occurred at the same spot, at different times. Previous to the first "disruption, there was observed a bulging, or swelling out, of the metal, which gradually increased until it became nearly of a hemispherical figure, when it burst open and let the water out of the boiler into the fire. The boiler was repaired by putting a thick patch of malleable plate iron over the hole, when after about six weeks wear and exposure to the fire, this metal bulged out again, and burst asunder; a third patch was substituted, and in about a similar period of time was destroyed in like manner." "The cause of these ruptures appeared upon investigation to be owing to a partial and very intense heat impinging against that particular spot where they took place." If to this detail had been added proofs that the first rupture was not caused by sediment, nor by a defect in the metal, the evidence would have been complete. It is not, however, probable, that either of these causes were actually operative, since the second and third plates are stated to have bulged out, in the manner of the first, and if sediment had collected at this spot, it could not thrice have escaped notice. The defect in malleable iron, to which the Committee alluded above, is the want of connection in parts of a plate, resulting from imperfect welding before rolling, and which sometimes separates the plates into distinct layers, for a considerable extent.

In the communication just referred to, Mr. Hebert further states, that the disruption of a boiler, occurring twice in the same place, was traced by Mr. John Martineau, a respectable engineer of London, to the impinging of a current of air upon this spot.

67. A case apparently of the kind now under discussion, but which was found subsequently, to be due to the imperfect union of the parts of a sheet of metal of the boiler is as follows: Part of a boiler belonging to Messrs. Merrick and Agnew, of this city, was observed to be protruded, in a similar way to that described by Mr. Hebert. Suspecting the presence of sediment, the boiler was examined and found to be clean. It was a cylindrical boiler, of wrought iron, the fire applied on the exterior and at one end, and without interior flues. The fuel was anthracite coal. The effect was next attributed to the intense local heat produced by this fuel, and the grate bars being lowered the swelling made no further progress. It has been since ascertained that there was a separation into laminæ of the iron, at this place, requiring the removal of part of the sheet.

68. While, then, the evidence in the cases preceding the last is certainly incomplete, the Committee conceive that they are leaning towards the side of safety by admitting the possibility of the occurrence of danger, to the engineer and fireman at least, from peculiarities in the arrangement of a boiler, or of the fire which heats it.

69. In these remarks it has been supposed that there is a considerable column of water over the metal; if that should not be the case it may well happen that the steam-bubbles will form so numerous on, or near, the iron as to allow it, while they rest there, to become heated above what it would be, if the water were in absolute contact with the metal.\* This will especially occur with a viscid fluid, such as salt water, or water with much sediment suspended.

70. The views suggested by the several sections of the preceding head are the following:

\* Replies, &c., No. II. Communication of "an Engineer." *Philos. Mag.* vol. i. p. 403.

1. The feeding of a steamboat boiler should not be done at intervals, but go on throughout the working of the engine.

When the engine is stopped, as at a landing, or to take up passengers, &c., the water should still be supplied by the engine itself, or by a subsidiary one, or by hand. In this case the free safety valve should be raised. The practice of wasting water by opening a valve, when the forcing-pump is not in action, is considered dangerous.

2. If the water should by any accident get down so as to expose a flue or flues, the fire should be in part extinguished, to cool the boiler before adding water. If the engine is at rest, in such a case, it should not be put in motion. If it is in motion it should be slackened, or stopped, the furnace doors opened, and the heat got down. Then water may be thrown in. The opening of a safety valve should in such a case be avoided. The engineer should remember that as life is at stake, he cannot be too prudent.

Such a condition of things, however, ought never to be allowed to occur, and the responsibility for the danger which results must rest upon the master, the engineer, and his assistants.

3. If a self-regulating apparatus for the supply of water is used it should be closely watched, and on no account be implicitly trusted to. It may be a convenience, but can, in no case, be a substitute for human care.

4. For ascertaining the level of the water within a boiler, the Committee recommend the glass tube water-gauge, a form of which is shown in the foregoing pages (p. 296).

5. The Committee recommend for every boiler a fusible metal apparatus, the metal of which shall be inclosed in a tube, so as not to expose it to pressure.

In boilers without flues it should be attached at the water-line; in those with flues, at the highest part of the flues; or if level, at the part likely to be most rapidly heated, as at the juncture of several flues into one, a sudden change of direction, or the place of most active combustion of the fire.

The form described in the report (pp. 297-298,) is convenient, and the lever should act upon a bell, and upon a small cock. The apparatus should be inclosed, the master of the steamboat having the key of the inclosure, which should further be so arranged as to protect the apparatus from the weather.

The quantity of metal should be no greater than is required to keep the rod in its place. The metal should be regulated so as to melt at a temperature of fifteen degrees\* above that corresponding to the working pressure. Tables for this purpose, will be found annexed.†

\* This difference of pressure corresponds at a pressure of two atmospheres, to half an atmosphere or one-half the bursting pressure, and at eleven atmospheres to rather more than two atmospheres, or one-fifth of the bursting pressure. The difference is not, however, too great at low pressures, because an excess of strength may rather be expected in the low pressure boilers as now made, and the alloys, containing bismuth, pass through the different states from solidity to liquidity, by slow degrees.

† While correcting the proof sheets of this No. of the Journal, we notice in the LONDON MAGAZINE OF POPULAR SCIENCE, for last month, (September, 1836,) a paltry criticism of this proposition of the Committee—"to enclose the fusible metal in a case in which it shall not be exposed to the pressure of the steam, but only to its heating effect."—After quoting the sentence, the Magazine critic, triumphing in the fancied discovery of a good American bull, exclaims—"but *cui bono?*—for what purpose?—the metal is in a case! not exposed to the pressure of the steam! How then is it to act efficaciously as a means of relief to a boiler dangerously increasing in temperature? *How is it to act at all, though fluid as in a crucible?*" The conclusion he then arrives

If the metal is melted, the injection of water, or the opening of the furnace doors, will reduce the temperature of the heated parts; or lower the pressure of the steam if that should have been too high, and the safety valves be out of order.

By sounding with the rod, it will be ascertained when the metal is about to recongeal, as it becomes a soft solid into which the rod may be forced. If, accidentally, the metal congeals without taking in the rod, the end of the latter being heated, will melt the fusible alloy.

If the safety-valves do their duty, this metal will never be melted by increase of temperature, caused by an increase in the elastic force of the steam.

6. The true remedy for undue heating of boilers by deposits is frequently cleansing them. When this is impracticable, blowing out should be cautiously resorted to, so as not to lay the flues bare of water. The danger from these deposits is especially great in salt water, and muddy water mixed with calcareous matters. It should be guarded against by ascertaining the time required for the water used, to make a sensible deposit. No general rule in regard to this can be given, since boilers in different places and even those fed by springs at short distances apart are liable to deposits in different times.

Negligence on this point will always produce the rapid destruction of a boiler, and may cause it to burst, or even to explode.

No substitute for the care just recommended, has yet been found.

7. The following table of fusible alloys applicable to boilers working at pressures from one to thirteen atmospheres, is deduced from the experiments of the Committee.\* The alloys are those determined approximately, which at temperatures severally 15° Fah. above the working temperatures will allow a metallic stem to be drawn out from the mass. The principles which guided the Committee in their experiments may be seen by referring to Part I. of their Report (p. 36, &c.) The proportions are given in parts by weight.

*Table of alloys for use in closed tubes, and with a metallic stem.*

Working pressure in atmospheres.	Tin.	Lead.	Bismuth.	Working pressure in atmospheres.	Tin.	Lead.	Bismuth.	Working pressure in atmospheres.	Tin.	Lead.	Working pressure in atmospheres.	Tin.	Lead.
1½	8	8	7.5	4	8	8	3.4	8	8	8	12	8	12.3
2	8	8	6.2	5	8	8	2.2	9	8	9.8	13	8	13.2
2½	8	8	5.3	6	8	8	1.2	10	8	10.6			
3	8	8	4.6	7	8	8	0.5	11	8	11.4			

(TO BE CONTINUED.)

at is,—“There must be a district in Pennsylvania where the Shamrock is worn”! And he further thinks, that our sage Committee would be likely to propose, as the best means of preventing the loss of a key which would alone open a box, to *shut it up in the box!* We recommend to this ingenious critic to read this part of the report of the Committee carefully over again, and try whether he can discover no good reason suggested for enclosing the fusible alloy in a tube,—and no substantial answer to his *cui bono?*—If his own vision should fail him, perhaps he will do us the favour to borrow that of some *intelligent* friend. We are not aware that the “Shamrock” is at all indigenous to this country, though we have thistles and thorns a plenty. G.

\* Report of Com. on Expl. Part I. p. 36. Jour. Frank. Inst. vol. xvii. p. 86.

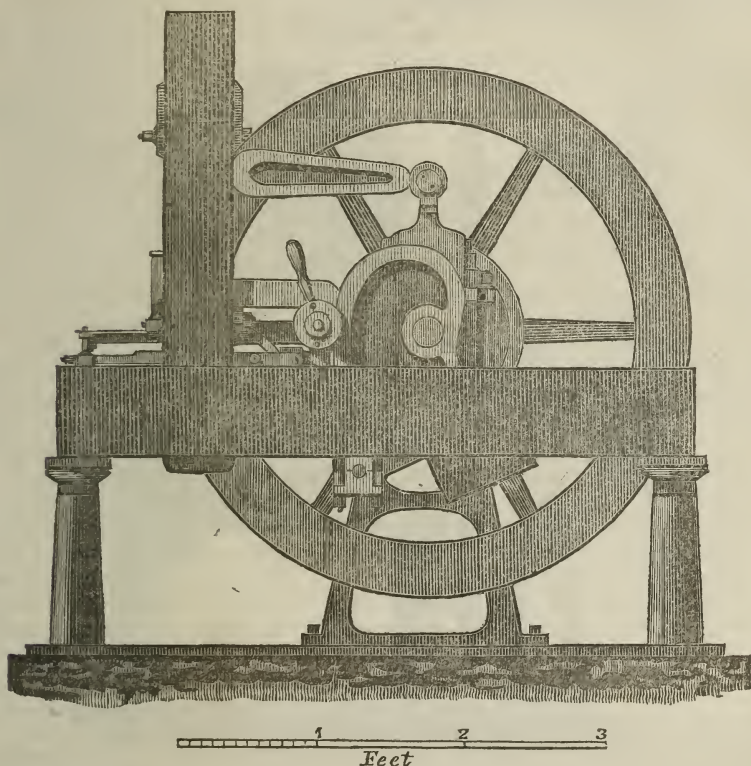
*Description of the new Coining Presses lately introduced into the U. S. Mint, Philadelphia.* By FRANKLIN PEALE, Esq.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN:—After seven months of experience, it will not be considered premature, to send for publication, a brief notice of the Coining Press, a model of which I had the pleasure to exhibit and describe, at one of the Conversation Meetings at the Institute last year.

This press has been in operation since the 23rd of March last, the period of the first coinage by steam in the Mint of the United States; and the results, which are more than satisfactory, have authorized us to proceed with the most perfect confidence in the formation of the presses for the Branch Mints at New Orleans, and at Charlotte and Dahlonega, in North Carolina and Georgia; also, with the manufacture of others for the use of this Mint, all of which, it is probable, will be completed at an early period in the coming year.

*Side view of the Press.*



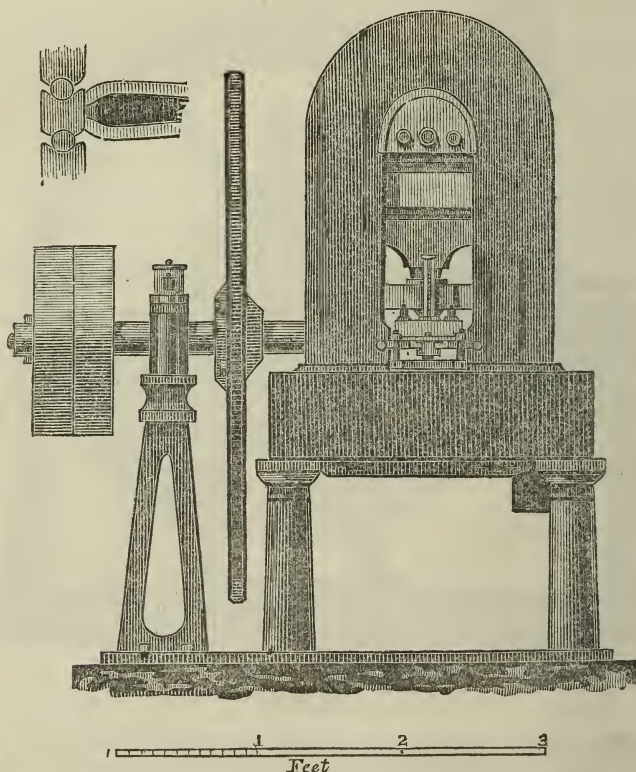
The above design exhibits a side view of the medium size press, intended to strike eagles, quarter dollars, and cents. Three grades have been adopted, corresponding in linear proportions to the numbers  $9\frac{1}{2}$ , 7 and 6, suited to all the denominations of our coin respectively.

The design exhibits the general proportions and arrangement of parts, consisting of a shaft with a fast and loose pulley to receive motion by means of a strap from the moving power, whether water, steam, horse, or hand:—

the latter, of course, being least desirable, will only be used, when neither of the others is available. Upon this shaft is placed the fly wheel, the momentum of which, during one revolution at the rate of sixty per minute, is found, on trial, to be quite sufficient to overcome the resistance offered by the piece whilst subjected to the pressure of the dies. Upon the same shaft is the crank, which gives motion, through the pitman, to a lever and toggle-joint, the structure of which is exhibited in the left upper corner of the front view presented in the next figure.

The feeding in of the blanks, or planchets, and their discharge after being struck, is performed by an eccentric and set of levers, all combined in so simple a manner, as to be effectual, and not subject to derangement; as much of these parts as are visible in the two views, are faithfully exhibited, but it is impossible to describe them intelligibly without the aid of drawings of the separate parts; and, further, since the drawings were executed, changes have been made in the position and form of the eccentric, by which the press has been much improved; a general notice is all that is intended in the present communication.

*Front view.*



The feeding tube is a vertical pipe to receive the blanks, in which they are placed by hand, and from which they are taken by the feeders; the latter are so arranged, that when a crooked, or otherwise faulty blank impedes the motion, (not an unfrequent occurrence in coining,) the whole

is immediately released from action, and will not again operate until the impediment be removed.

A few familiar facts are added as evidences of the peculiar adaptation of the toggle-joint to coining, as proved by the operation of the press which is the subject of this notice.

1. The pressure acts with increasing force until the close of the operation, at which time its intensity is greatest, and it is always carried to the same extent.

2. No injury occurs from the absence of a blank from between the dies when the blow is given, an accident that results in the destruction, or great injury, to one, if not both, of the dies, in presses of the ordinary construction.

3. An immense saving of labour. From trial, we have ascertained, that a man, with one hand applied by means of a common winch handle, can coin eighty pieces per minute, (the experiment was tried upon cents, which have a diameter of  $1\frac{1}{10}$  inches.). A boy, fourteen years of age, was able to coin sixty per minute, without any unusual exertion; and lastly, it was impossible for the operator to tell, by the resistance offered to his exertions, whether the pieces were being coined or not.

It is by no means my wish to be considered the first who has applied the toggle-joint to the striking of coin. It is difficult to say to whom priority belongs; for presses on similar principles, are in use in more than one city of Germany, and their successful operation was witnessed at Carlesrhue, in the Grand Duchy of Baden. Particular advantage has also been derived from a careful examination of the coining presses of Monsieur Thonnellier of Paris. It is just to observe, that none of these presses were perfectly satisfactory. I have, therefore, made my own distribution and proportion of parts, thrown off whatever was complex, and added such as were necessary to its perfection, particularly, the arrangement for the disengagement of the feeders in case of the presence of defective pieces.

Our esteemed friend and fellow-citizen, Mr. M. W. Baldwin, several years since, commenced the construction of a press on similar principles. His talents and mechanical skill are amply sufficient for its completion; and it is to be regretted, therefore, that his numerous occupations have prevented his prosecution of the subject.

I take advantage of the present occasion, to make a few remarks on the application of steam power to coinage, as applied in the Royal Mint, on Tower-hill, London, which is one of the greatest curiosities in mechanics that I have ever seen, exhibiting consummate skill and great resources, on the part of the inventor, who, if I am not misinformed, was Mr. Boulton of Soho Works. For a series of years this machinery was kept rigidly secret; some even of the officers of the Mint not having the favour of seeing it accorded to them, and it might yet have remained so, if it were not for the advancement of liberal principles, which bid fair to keep pace with the rapid increase of mechanical ingenuity and skill.

The direct application of high steam to the screw press, would have answered every purpose, but still better, the substitution of the toggle-joint for the screw has rendered all this ingenious complexity unnecessary; but mechanicians may make their own inferences from the following sketch.

A low pressure engine, is employed to create a vacuum in a large receiver, (in this case a misnomer,) by means of an air pump, which serves as a reservoir of power, through the agency of which the pressure of the atmosphere, is exerted as occasion requires, both for the *blow* and *recoil* of the screw press, the former, produced by a cylinder and piston, furnished with valves, one of which opens to the reservoir, and the other to the exter-

nal air, the latter, by a cylinder and piston, constantly acting, but with less power than the former. The valves are moved by levers which are struck at the proper time by a *plug frame* of similar construction to those employed in the ancient atmospheric engine. The power is communicated to the screw by tumbling shafts, connecting rods, and levers, the construction and operation of which could not be rendered intelligible without full drawings for reference. More words would, perhaps, render this brief notice as mysterious as the contrivance of which it treats; I will, therefore, close, by adding that eight of these systems, attached to eight screw presses, constitute the coining power of the British Mint.

*On the management of Turn-outs on Rail Roads.* By A. C. JONES, Engineer.

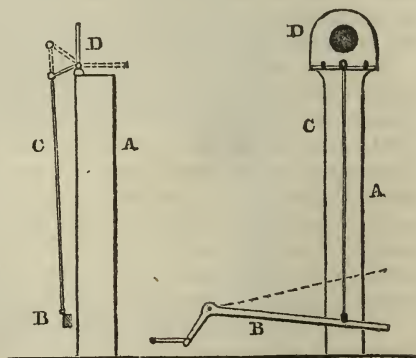
FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

GENTLEMEN:—At the present rapid rate of traveling on rail roads, it is a desideratum (in point of safety,) to know that the switches of the turn-outs are in the line of the road, so that the train is not necessitated to be much checked, in passing over them. The best method for insuring the right position of the switches, is that used on some short roads, by having a man stationed at them; but on long lines of road, where there are many turn-outs, this is not practised, owing to the expense attending it. As a substitute, a ball is placed on the end of the lever used to shift the switches, to show their position. This, I believe, is the best plan in use; that it is defective is proved by the numerous accidents occurring on rail roads by running off at the turn-outs, it not being foreseen that the switches are wrong. Where the turn-out is in, or at the end of a curve, it is difficult to tell by the ball how the turn-out stands, until you are so near as to make it impossible to stop in time, if it is not right.

The following arrangement will have a tendency to promote safety in this particular, and the additional expense will be but trifling. Instead of the ball, I propose having a board placed on the post, its face at right angles to the road, with hinges fastened to one edge, and from its face extends a short lever, which is connected to the lever that moves the turn-out, so that when the switches are changed, the dial, or board, takes either the horizontal or vertical position. This will be shown more fully by an inspection of the cuts.

On a curve or grade, this method would have the same advantages as on a straight part of the road, and it is evident, the face or edge being presented to the engineer, that he will be thereby enabled to judge how the turn-out stands, at a greater distance from it, than by the method in practice, and will consequently admit of his stopping the train in time to prevent accidents.

A. The post. B. The lever. C. Connecting rod. D. Dial.



Respectfully, yours,

*Philadelphia, Sept. 1836.*

A. C. JONES.

This appears to be a good suggestion. A board, or disk, with a black circle in the centre, surrounded by a broad white border, would be more

conspicuous, and its position, in the way proposed, more easily perceived than the ball now in use. In turn-outs that are much used, it may be expedient to keep a lamp burning during the night, to show the position of the disk. It seems desirable, however, that every precaution should be taken to prevent the necessity of stopping a locomotive train in order to adjust the switches of a turn-out.

J. G.

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### Franklin Institute.

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#### COMMITTEE ON SCIENCE AND THE ARTS.

##### *Report on Mr. C. Kenzie's Water Wheel.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination the model of a Water Wheel, invented by Mr. C. Kenzie, of Troy, New York, REPORT:—

That they have carefully examined the object submitted to them, and find that it is a modification of the tub and the undershot wheel. The peculiarity of the invention consists in receiving the water from a number of chutes at once, distributed around the periphery of the wheel. The buckets or float-boards, are set in the direction of the radii, and the water is directed as nearly as practicable in the line of a tangent to each float. In this arrangement the water is, of necessity, discharged from the wheel within the rim, or shrouding, and is allowed a free escape on both sides of the wheel. The wheel is placed in a horizontal position, at the bottom of the fall, entirely under water, and is surrounded by a box or tank of an equal depth with the wheel, to which it is accurately fitted to prevent the escape of water between them, whilst it permits the latter to revolve freely.

The supply of water is through a water-tight trunk connected with the tank, by which the entire head and fall is made available, the wheel being sunk below the lower level as before stated.

One of the benefits arising from this arrangement, is that of the water being received on the wheel in a compact form, owing to the spaces being kept always full by the centrifugal force. A principal advantage, however, is that of being able to employ a much greater quantity of water than could be brought to bear upon the floats by any other wheel of equal size.

The Committee believe that the advantages above enumerated, are in accordance with the principles of hydrodynamics, and that its inventor has attained a high degree of perfection in that description of wheel, and they are happy to add, that so far as their knowledge extends, the arrangement is new.

The Committee take leave to suggest, that since the water always retains a part of its power, proportionate to the square of its velocity, on leaving the wheel, no inconsiderable portion of it would be saved in this instance by extending the buckets to the centre, so as to deliver the water at as low a velocity as possible; and they would also recommend the use of a partition which should cause all the water to take the same course in the floats. In this case the rim must of course be made wider so as to contract the diameter of the opening to what would be just sufficient for a free delivery of the water.

By order of the committee.

Oct. 13, 1836.

WILLIAM HAMILTON, *Actuary*.

*Report on Mr. Holcomb's Reflecting Telescope.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination a Reflecting Telescope, made by Mr. Amasa Holcomb, of Southwick, Massachusetts, for the Newark College, Delaware, REPORT:—

That the following description of the instrument is given by Mr. Holcomb: "The telescope submitted to the examination of the Committee is a Reflector on the plan of Sir Wm. Herchel. It is fourteen feet long and ten inches in diameter. It has six different magnifying powers from 70 to 1000."

The Committee proceeded to the examination of the telescope on the evening of the 17th instant. A trial was made of its various powers from 70 to 1000, upon the moon, upon several nebulae, clusters, and double stars, and they beg leave to report as the result of that examination, that the instrument possesses all the superiority over any reflectors hitherto submitted by Mr. Holcomb, which its increased length and aperture would lead us to expect, and that it has every attribute of excellence which the best optical skill could give to an instrument of these dimensions. The Committee cannot forbear again commenting upon the excellence and simplicity of Mr. Holcomb's method of mounting the instrument, which notwithstanding its size, is portable, with all its mounting, by a single person.

The object is easily followed by the rack work and the inconvenience from the motion of carriages at short distances from it, was not found to be greater with a power of 1000, than with a power of 100, in the common mode of mounting achromatics, moveable by rack work on an upright stand.

The short time allowed the Committee prevented them from making observations on close double stars, for the purpose of determining the limit of its optical capacity. All of which is respectfully submitted.

By order of the committee.

Oct. 13, 1836.

WILLIAM HAMILTON, *Actuary.*

## Mechanics' Register.

### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1836.

*With Remarks and Exemphifications by the Editor.*

1. For a machine for *making and Cutting Crackers*; William R. Nevins, city of New York, March 2.

A claim is made to "the peculiar arrangement of the machinery as described, by which the operation of the rolling of the dough, and cutting the biscuit, or crackers, is performed at the same time and with the same machine. Also, as an improvement, the horizontal rack or pinion by which motion is given to the cutters."

The description of the machine is very imperfect, and the drawing lends but little aid in exhibiting the "peculiar arrangement" of its parts. There are to be two, or more, pairs of rollers to roll out the dough; a moveable table, or apron, to carry it under the cutters, and the frame carrying these cutters is to be raised, we believe, by cams, or lifters, and is to fall by its own gravity. There are many other machines in which the rolling and cutting are performed at the same time, this, in fact, is common to the numerous instruments which have been contrived for making crackers.

2. For a *Power Printing Press*; Isaac Adams, city of Boston, Massachusetts, March 2.

We cannot attempt to give any description of this press, the specification of which occupies sixteen pages, with numerous references to the drawings; the claims amount to twenty-one in number, and it will be a fortunate, and very remarkable, circumstance, should the whole of them prove tenable. The press has been tried, and we are informed that it operates well, and is much superior to that patented by the same gentleman, which was itself a good one. The combinations in the present instance are sufficiently novel and characteristic to render it unnecessary to resort to minute particulars in the claims, a course which is commonly pregnant with danger; if one thing only that is essential to the existence of a machine is claimed, it is safe to trust to this alone. In the case before us, we could point out more than one thing claimed which is not new, and the patentee himself informs us respecting one of them, that "the claim last above written, on the nippers, is not to extend to cylinder printing machines;" a court and jury, we apprehend, would not regard such a limitation.

3. For a *Stove for Cooking and Warming Rooms*; Foster Stevens, Springfield, Hampden county, Massachusetts, March 2.

The general form of this stove, as represented, is that of the common Franklin, or open, stove; but in this form it is to be used for heating only; when employed for cooking, a close, or box, fire place, is produced by means of two plates hinged together, and folding up against the back of the stove; one of them, when unfolded, forms the top of the close stove, and has perforations for cooking utensils; the other makes the front, and has folding doors to supply the fire. There are wing plates, which when not used to complete the enclosure, fold against the sides of the stove.

The claim is to "the combining the cooking stove with the common fire place, or fire frame, by means of the folding plates and wings, and the closing of the lower flue by means of the plate when folded back, so as to cause the smoke and heat to pass off as in a common fire place."

Such folding plates are apt to be troublesome, and are liable to get out of order, by warping from heat, the insinuation of ashes, &c. about the joints. Should there be no difficulty of this kind, we are not aware of any thing which will interfere with the claims of the patentee.

4. For *Apparatus for heating buildings, and for Cooking*; Lovell Lewis, Lewiston, Niagara county, New York, March 2.

A stove of any of the usual kinds is to be employed for the combustion of the fuel, and this is to be surrounded by a casing of tin, allowing a space between them; the stove pipe is to be surrounded in the same way by a tin case, which is to be closed at top. From this casing tubes are to lead into any part of a building to be heated; and when cooking is to be performed, the articles to be operated on are placed within the casing, which is furnished with doors for that purpose. The claim is to "the method, or manner of collecting, retaining, conducting, and using, heat, for the purpose aforesaid."

Although we have good and bad conductors, and good and bad radiators of heat, we cannot by any of our devices, bottle up, and retain this subtile medium, as we can bottle up and retain water; neither will it, at our bidding, pass through tubes, or be drawn off by pumps and cocks, in the manner of

liquids. But apart from this, the foregoing description sets forth no new discovery, as tin cases to stoves and furnaces intended to arrest and retain the heat, are well known devices, and have been made the subject of patents in various instances.

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5. For a *Washing machine*; John O. Geer, Norwich, Connecticut, March 2.

A cylindrical barrel is to be placed horizontally, and within it are to be revolving dashers. "The construction of the inside movements, and the operating of the same," constitute the claim.

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6. For a *Safe for protecting account books, &c. from destruction by fire*; Daniel Harrington, city of Philadelphia, March 2.

A firm enclosure is to be built of brick, or stone, extending from the cellar up to the floor of the apartment in which the safe is to be used. The safe itself may be made of wood, and is to be suspended by pulleys and a counter weight; sliding and folding doors of iron shut down over the safe, when it descends into the fire proof case, or well; these being of sufficient strength to prevent any danger from walls, or rubbish, falling upon them, and being so contrived as to be, to a certain extent, self-acting, covering the safe as it descends. The particular devices we cannot take time to explain, but think them such as are well calculated to answer the purpose intended.

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7. For *Cutting and forming heads for barrels, &c.*; Hiram Andrews, Canaan, Litchfield county, Connecticut, March 2.

Various machines are in use for cutting heading for casks, &c., but that described in the specification of this patent appears to be sufficiently new, to justify a claim to invention. The heading is to be cut rounding by means of a concave, circular saw on a revolving shaft, within which saw there is a circular cutter, of somewhat less diameter than the saw, and in contact with it, furnished with teeth so formed as to give the proper bevel to one side of the head. A similar cutter on another shaft bevels the opposite side of the head, the latter being properly secured on a revolving platform, operating as a chuck. The drawing is very indifferently executed, affording but a general idea of the machinery, and is, therefore, not such as the law requires. The specification affords a good general description, but no more; and the claim is to "the combination of the several parts of the machine, and the placing them in the position which effects the object of cutting and forming heads for any casks of any dimensions." Such a claim we do not think good, as it does not designate any particular combinations, as characteristic of the machine, whilst several of the things combined, have been similarly arranged in other machines, for the same, or other purposes.

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8. For a *Self-sharpening pick for dressing mill stones*; Samuel Etheridge, Tecumseh, Lenawa county, Michigan, March 2.

This invention is claimed as applicable to stone hammers, as well as to picks for mill stones. The hammer, or pick, consists of two pieces of iron, embracing a plate of steel between them; to one of these pieces the handle is fastened, by passing through it in the usual way, and against this the other piece, or jaw, is to be forced by means of a wedge, so as to hold the steel plate firmly.

CLAIM. "What I claim as my invention, and not previously known, in the above described pick axe, and chisel, is the making of the point or cutting part a separate and distinct piece from the body; the manner of holding it between two jaws held together by a strap, with the key, or a screw; the manner of sliding it down and fastening so that it will not drive back again; and the making of the point of one thickness of steel between two of iron welded together, so that the iron will wear off faster than the steel, and thus constitute a self-sharpening point."

By turning to page 25, vol. xvi., it will be seen that the first member of the foregoing claim is in terms which cannot be sustained.

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9. For an *Instrument for perforating Wood*; John B. Pell, city of New York, March 2.

This perforating instrument consists of a cylindrical steel tube, well polished within and without; it has at one end a cutting lip, and, if preferred, an entering screw, and at the other there may be a handle like that of an auger. The tube is somewhat smaller at the cutting than at the handle end, and the chips which pass into it are, consequently, not obstructed in their passage through it. Besides the perforating instrument, the specification describes and claims a machine for working and directing it, by means of a guide screw, and other appendages.

CLAIM. "What I claim is, first, the tube perforator which casts its cuttings through the tube or heart of the instrument, and bores without clogging with its own cuttings; and, secondly, the labour saving machine for giving a rotary motion to the perforator, more advantageously than by a handle worked in the manner of a common auger."

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10. For an improvement in *Piano Fortes*; Isaiah Clark, Cincinnati, Hamilton county, Ohio, March 2.

The patentee states that he makes an entire and distinct frame of iron, which frame is to bear the whole strain of the wire, or strings, and claims "the entire iron frame, made of cast or wrought iron, or any other suitable metal; also the sounding board, on account of its being attached to the said frame; and also the peculiar direction of the treble strings." The treble strings are nearly at right angles with those of the bass.

We did not suppose that there existed a single piano forte maker who was unacquainted with the fact that pianos had been made with *entire iron frames*, in France, England, and the United States; it appears, however, that we were mistaken.

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11. For a *Brick Press*; Phineas Ball, Mount Vernon, Knox county, Ohio, March 2.

This machine is intended for pressing untempered clay by what is denominated the double-actioned joint levers; the main point depended upon appears to be the pressing of the brick clay in the mould by a follower on each side of it, one working up, and the other down. The general construction of the machine is shown in the drawing, but there are several particulars not so explained as to enable a workman to construct a complete machine. The claim is certainly broader than the invention; it is to the giving to the levers that double action which causes the material to receive an equal pressure from above and below; and also the invention of pressing the brick on the edge, or face; likewise the improvement in the art of making brick by pressing untempered clay; together with the general com-

bination and arrangement of the respective parts, as herein described, by which this machine is distinguished from all others constructed for the same purpose."

We are confident that bricks have been pressed by double followers in machines previously made, and there are numerous patents for making brick by pressing untempered clay.

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12. For *Forge furnaces, and steam engine boilers, in combination*; Alexander Harrison, New Haven, Connecticut, March 2.

The body of this combined forge and furnace is represented as nearly egg-shaped; into the lower part, or air chamber, the wind is to be forced, and is to pass up through a grate upon which the fuel lies; the furnace, or forge, occupying the middle portion of the apparatus; into this part there are several openings, or doors, giving access to the fire; the upper part of the egg-formed body constitutes the boiler, which in part, also, surrounds the fire.

The claim is to the "combination of a steam engine boiler with a forge furnace, constructed substantially as aforesaid; that is, with a boiler so formed as to constitute the sides and top of the forge furnace."

There are several things alluded to, which are not explained; the use and application of the apparatus are also very vaguely presented.

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13. For a *Saw mill dog, or carriage stock*; Jesse Reed, Marshfield, Plymouth county, Massachusetts, March 2.

Various modes of forming dogs for holding, and slides for setting, the logs on saw mill carriages, have been made the subject of patents. The things claimed by the present patentee, are a "notched slider, a hand, weight and lever, a lock joint of a knee, a swivel brace, right angled dogs, and the method of confining them, as described, with their arrangement." Some of the parts individually claimed are not new; as, for example, the *notched slider*, which is a bar of iron forming a rack on its lower edge, and having the right angled dogs on its upper side. The notches, or teeth, on the lower side of the slider, are for setting the log, which is to be effected by the running back of the carriage, in a manner very similar to that adopted by Phineas Bennett. The mode of action is not exhibited sufficiently in detail, to instruct a workman, we cannot, therefore, speak with confidence respecting its originality.

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14. For an improvement in the *Axles of wagons, carriages, &c.*; Spencer Coleman, Mount Pleasant, Spottsylvania county, Virginia, March 2.

These axles are called rolling axles, and from the description it appears that they are so denominated from the whole axle being allowed to revolve in boxes fixed on the bolster, or other suitable part, of the frame of the carriage; whether the wheels are also to revolve freely on the axles we are not told, but suppose that they are, otherwise there would be a difficulty in turning the carriage. There is not any claim made, and the patentee is in error in supposing, as he must, that the revolution of the whole axle is a novelty.

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15. For a *machine for breaking dough, for making bread*; Daniel

D. Shackford, and Theodore Shackford, Westbrook, Cumberland county, Maine, March 2.

A circular platform, surrounded by a curb, or rim, converting it into a shallow tube, or trough, is made to revolve horizontally by suitable gearing; within this the dough to be broken is placed, and is operated on by a fluted frustrum of a cone which presses upon it; this frustrum has projecting axes which are suspended by a rope, or chain, from the upper part of the frame of the machine, allowing it to roll freely, and to adapt itself to the surface of the dough. The claim is to "the combination and arrangement of the foregoing machine for breaking dough."

Machines nearly identical with this have been used for washing clothes.

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16. For *Rotary stove caps*; Maynard French, city of Albany, New York, March 2.

According to our understanding of the description of these rotary caps, or tops, of cooking stoves, they differ from those used in Stanley's well known rotary stove in being elevated three, or more inches above the upper fixed plate of the stove, by a circular rim, all around the cap, there being divisions, or descending partitions, on the under side of the cap, between the different openings for cooking utensils; this arrangement being substituted for the circular rim surrounding each opening on the upper side of Stanley's stove cap. The claim made is to "the elevation of the cap, or caps; the formation of the chambers by the various partitions on the under side of the cap or caps; the methods of conveying the smoke and heat from chamber to chamber; [by openings in the partitions,] and the adaptation and application of the said caps to stoves and furnaces, as above described." We see no essential difference between these caps, and those used by Stanley; nor any superior advantage to be derived from them.

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17. For an improved machine for *Renovating and purifying Feathers*; John W. Post, and Ralph Collier, city of Baltimore, March 2.

Two plans of operation are here proposed; one of them is to put the feathers into a double cased vessel, provided with agitators to stir them up; they are to be heated by admitting steam from a boiler between the two cases, so that it may not come into contact with the feathers. The second plan is to dress the feathers without taking them out of the bed; an opening is to be made through the tick at one end, and a recurved metallic tube is to be inserted, through which steam and heated air are to be passed, the bed being occasionally shaken during the operation.

The claim is to "the apparatus as above constructed, and particularly the introduction of heat into beds, without taking out the feathers."

We do not believe that either of these plans will be so effectual as those in which moisture is allowed to come in contact with the feathers, and as respects that *particularly* claimed, we are convinced it will be productive of little, or no, benefit.

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18. For a *Churn*; Amos Hanson, Windham, Cumberland county Maine, March 2.

The cream is to be put into a square box with a curved bottom, and to be agitated by means of revolving *ladle boards*, or dashers, which are to be

moved by a cog wheel and pinion. The claim is to "the gearing that is attached, and that operate said machine"!!

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19. For an improvement in the *Printing Press*; John L. Kingsley, city of New York. First patented, April 22, 1835. Surrendered and reissued March 2nd, 1836.

We remarked upon this press as originally patented, at p. 328, vol. xvi. and noticed the defectiveness of the claims made; these are now in the following words: "What I claim as my own original invention in the machinery, is the universal joint of the ball in two sockets; the double joints of the connecting rod, roller, and standards; the manner of regulating power by the screw die and binding nut; and also to the lever, and its manner of connexion."

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20. For a machinery for *Making Gauges for cabinet makers and joiners*; Morris M. Brainard, Great Barrington, Berkshire county, Massachusetts, March 4.

This machinery consists of a socket chisel for boring and mortising the heads; of a grooving drill, or cutter, for grooving the bar to receive the slide; of a sliding scraper for fitting the slide to the groove; of a burr saw for dressing the gauge bar; and of a revolving shaver for finishing the head of the gauge, and bringing it into proper shape. Most of these are revolving cutters used in the lathe, and adapted in form to the purpose for which they are intended, but not possessing any of that kind of novelty which would class them among inventions. They can hardly be said to be described, yet it would be easy to make similar tools by referring to the drawings, not from the special clearness of these, but from a familiarity with similar articles.

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21. For a *Composition of Pitch*; Thomas H. Sherman, Scriba, Oswego county, New York, March 4.

To make this composition; twenty-five pounds of water lime, and eight and one-third pounds of salt are to be added to 100 pounds of common pitch; the lime is to be added first, then the salt, "and all the process is to be effected over a moderate fire. This gives a substance superior to common pitch, inasmuch as it is harder in the water, and wherever placed remains permanent."

The foregoing comprises the entire substance of the specification, in which there is not any claim made. We have known lime and salt added to tar, and the whole boiled together, which, we apprehend, produces a result the same with that of the foregoing recipe. This composition we have seen employed with good effect, for covering shingled roofs. Sparks falling upon it are not so likely to produce combustion as upon dry shingles.

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22. For *Applying Plaster of Paris, in forming Walls, &c.*; John Flint, city of New York, and Clark Mills, Syracuse, Onondaga county, New York, March 4.

A main object of this patent is to secure the right of using "plaster to form walls to obstruct the influx of water in pits where reservoirs are to be built." After digging the pit, plaster is to be sifted, or poured, into the water which is contained in it, so as to cover the bottom to the thickness of four or five inches; a suitable curb is then to be inserted, leaving a space of two or three inches between it and the walls of the pit, which space is to

be filled with plaster; the curb, and any contained water, are then to be removed, and the plaster covered with a coating of hydraulic cement. Reservoirs in grounds free from water, and also above ground, are to be formed on similar principles, instructions for doing which are given in the specification.

The things claimed, are the use of calcined plaster, either alone or mixed with other materials, for making walls, or guards, to obstruct the influx of water, in places where such influx occurs; also the use of the like materials for forming other cisterns, to contain liquids.

Hydraulic cement, without the intervention of Plaster of Paris, has been used in a similar way, for the same purpose, and we cannot perceive the advantage of using both. With respect to the claim above made, we do not think it tenable, as it does not contain any new discovery, or mode of procedure, or point to any "new machine, art, manufacture, or composition of matter."

23. For an improvement in *Locks and Keys denominated the Lever Lock and Key*; Augustus Prutzmann, city of Philadelphia, March 4.

A report upon this lock will be found at page 180; it having been submitted to the Committee on Science and the Arts. We cannot do better than refer to their report, as any attempt at description, without several drawings, would give a very imperfect idea of the construction of the locks. We have not looked enough into it to form a satisfactory opinion of its relative merits.

24. For an improvement in *Rail Road Cars*; Frederick Davis and William Ashdown, Baltimore, Maryland, March 4.

This is said to be an improvement upon the plan patented by G. W. Cleveland, on the 14th October, 1835, in which axles, divided in the middle, were employed in what was called a self-adjusting rail road car. The present patentees adopt the divided axle, each wheel turning independently, and being connected by a system of levers by which they propose to adapt the wheels to the curvature of the road, whatever that may be, and thus to prevent the vibrating, or zig zag, motion of the car, and preserve the flanch from contact with the rail. It so happens, however, that this vibratory motion is not caused by the curvature of the road, as it takes place as strikingly in the straight parts, and results from those perpetually recurring inequalities, which are unavoidable even on the best roads. The same defect attends the proposed plan as that which we have noticed in some others, namely, the fore and hind wheels are simultaneously acted upon; yet it must happen at the beginning and the end of every curve, that one pair of wheels will be on the curve, whilst the other pair is on the straight rails.

25. For a *Water Wheel*; Frederick Wingate, Augusta, Kennebec county, Maine, March 4.

The patentee intends to use this wheel, for "propelling mills, machinery of any kind, boats and vessels, by water power." Since obtaining his patent he has had time to try this wheel, and if he has done so, we are convinced that it is like many other things on trial, in the way of condemnation. The wheel is made in the manner of the common smoke-jack, consisting of a circular disk cut into six, or any other convenient number of, sections, by radial lines from the periphery towards the centre, and setting the sections

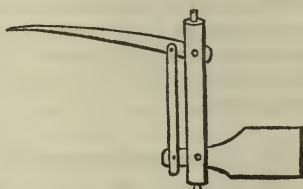
somewhat obliquely. Such wheels have been frequently tried, but not a second time, we apprehend, by the same person. They were essayed for propelling on the Hudson, by Gen. Stevenson, more than thirty years ago.

26. For an improvement in the *Bar-share Plough*; William P. Cannon, Monroe county, Tennessee, March 4.

CLAIM. "What I claim as my invention, and not previously known, in the above described plough, is the mortise, heel plate, and screw, on the horizontal bar, allowing the plough to be regulated in the depth by turning on the heel screw, instead of the eye or ratchet, which rendered the plough stationary as to depth, unless through the alteration of the horses' hames. And in discovering the property, and first making of the mortice in the upright, or perpendicular bar, so as to fix the plough at any depth desirable by the movable rivet."

27. For an improvement in the *Rudders for Ships and Boats*; Samuel Kepner, Harrisburg, Dauphin county, Pennsylvania, March 4.

Ships need not to have been mentioned, as this rudder will never be applied to them; it has been contrived for canal boats, and may possibly answer a good purpose in such vessels. The sketch in the margin will give a correct idea of the thing proposed, which is so to construct the rudder that by depressing the tiller, it will be raised out of the water, in which case it may be made to operate like an oar, enabling the helmsman the more readily to govern the boat.



28. For a machine for *Turning Boots*; Pelatiah Stevens, Jr., Stoughton, Norfolk county, Massachusetts, March 4.

We described a machine for turning boots at p. 266, vol. xvii, which undoubtedly answered the purpose perfectly well. The plan now proposed bears a strong resemblance to the above; the present patentee, however, states that he contrived his and put it into operation, prior to July, 1833. We are apprehensive that this statement will not aid him in sustaining his patent, as a public use of it for two or three years would abstract something from its novelty.

29. For an improvement in the *Printing Press*; Hezekiah Camp, Trenton, Tuscarawas county, Ohio, March 4.

This is called a *flexible tympan press*; and it is so called because the tympan, with the sheet upon it, is drawn down under a press roller, to receive the impression. A claim is made to the manner of throwing this press roller in and out of gear; also to the flexible tympan, self-operating clamps, &c. The drawing is not sufficiently in detail to show the construction of the various parts; and the flexible tympan, which is broadly claimed, is not new.

30. For an improvement in the *Steam Engine*; Nathan Lockling, Sparta, Lexington county, New York, March 4.

This improvement is, to us, truly transcendental; or, in other words, we

are unable to follow out the intention of the inventor, even with the aid of a well executed drawing. The furnace is within the boiler, and it is proposed to return the smoke and the escape steam back again through the furnace. To effect this object the flue from the furnace enters a drum, or case, furnished with a revolving fan, which is to drive the smoke, &c. &c., through a tube leading down behind, and under, the boilers, through which it passes, opening under the burning fuel. We see nothing to prevent a perpetual circulation of the same products of combustion. Besides this smoke pipe from the furnace, a steam pipe enters the above named casing, directly from the boiler, and is, in the drawing, called an escape pipe, and steam will certainly escape though it, but not that which we usually understand by the term escape steam. "We give it up."

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31. For *Cotton Gin Grates*; Edwin Keith, Bridgewater, county of Plymouth, Massachusetts, March 4.

This patent is taken for making the grates of cotton gins of chilled cast-iron. The method generally preferred, is to form the slots in the grates by laying plates of iron in the flasks when casting, which chills the parts where the saws operate; sometimes, however, the whole face of the grate is to be chilled. The claim is to "the making of grates for cotton gins of cast-iron, or other fusible metal suitable for the purpose, in sheets of two, or more, connected at the ends; and of chilling them either in the whole or in part, as described."

What "other fusible metal" is suitable for the purpose, we do not know; these words, it is true, will do no harm, but they are unmeaning, and intended to guard against some airy nothing.

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32. For an improvement in the *Plough*; David Prouty, and John Mears, Boston, Massachusetts, March 4.

The claims made consist, "First, in the inclining the land side, so as to form an acute angle with the plane of the shear. Second, the placing the beam on a line parallel to the land side, within the body of the plough, and its centre nearly in the perpendicular of the centre of resistance. Third, the forming of the top of the standard for brace and draught." These points, it is stated, are not claimed separately, but in combination with each other. This plough, we are informed, has been highly approved by those farmers who have used it.

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33. For an *Open Screw Wheel for propelling steam canal boats*; Aretus A. Wilder, Warsaw, Genessee county, New York, March 8.

The open screw wheel is to be made by floats upon a long shaft, forming an interrupted spiral; and this is claimed, with its application to the propelling of steam, canal, and other boats. If there were any novelty in this contrivance, we might descant upon its merits; but the patentee might find upon the shelves of the Patent Office, models of such wheels, long covered with the accumulating dust of years; much longer, we are fully convinced, than he will have them covered with water.

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34. For a *Double Force Pump*; Levi Newton, Alexander, Genessee county, New York, March 8.

As usual, in patents for pumps, there is nothing new in that before us. Two chambers, or cylinders, are placed in a well, and a brake carrying

two piston rods, works the two pistons, and forces the water up through a common pipe.

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35. For a *Splint for reducing fractures, called a sliding metallic Splint*; Enoch Thomas, New Athens, Morrison county, Ohio, March 8.

This splint is capable of being lengthened, or shortened, to adapt it to persons of different heights. We shall not attempt to describe the particular construction of any of its individual parts, as these do not constitute any part of the claim, although they are dilated upon in the specification. The claim is to "the combination, arrangement, and adaptation of the several parts of the splint, as described." A claim, which, like the splint itself, is calculated equally well to fit every subject.

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36. For a *Smut machine*; Marcus P. Spafford, Gainsville, Genessee county, New York, March 8.

A conical body is to revolve within a conical case, as in many other smut machines. Both the exterior of the runner, and the interior of the case are to be first covered with sheet-iron, and then with sole leather, and through these coverings iron teeth are to be driven, cut nails answering the purpose. A fan-wheel is employed to blow through between the runner and the case, so as to drive the separated smut, &c., entirely away. A second fan-wheel below the machine is to effect the final cleaning. The patentee says that he "does not claim any part of the above construction other than the combination of the leather and sheet-iron, to retain the teeth, and in separating smut from grain, so as that they shall be immovable; and also the adaptation of the fan on the top of the cone to produce a current of air downwards through the teeth."

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37. For *Leaching ashes, and making salts for Pearlash*; Elijah Williams, Erie, Erie county, Pennsylvania, March 8.

The instructions are to boil crude ashes in weak lye, or water, over a brisk fire, for about twenty minutes, the weak lye, or water, and the ashes, being in about equal proportions; this is to be let into the leach during the effervescence. The boiled ashes to be leached about eight inches in depth in the trough, boiling hot weak lye to be first used, and then boiling hot water. The lye is then to be boiled down in the usual manner.

The boiler should be made of sheet-iron, or copper, with a flat bottom, about three feet wide, and eight long, and twenty inches deep. The leaches to be of wood, with a flat bottom, and having a straw strainer, with a tube below for letting off the lye. Lye obtained by this process, and put through a lime strainer, will make good salts for melting. The claim is to "the boiling and leaching ashes, as above, without the use of lime, and making salts suitable for pearlash."

The above is the whole substance of the specification, if substance it have. To us, however, it is altogether obscure and indefinite.

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38. For an improvement in the method of *Making Mould Candles*; Jefferson Dunlap, Village of New Holland, Lancaster county, Pennsylvania, March 8.

This is an apparatus for passing the wicks into the moulds, giving them the proper twist, and drawing the candles simultaneously from the moulds.

The machine appears to be well adapted to the purpose, but would require more than a verbal description. The whole arrangement is claimed.

39. For a *Brick making machine*; John Moffet, Buffaloe, Erie county, Pennsylvania, March 8.

In this machine the bricks are to be pressed into moulds by the passing over them a loaded car, or carriage, beneath which is a pressing roller, extending the length of the brick. The moulds are placed side by side, in any required number, so as to form a long trough of cells. Parallel to this celled trough, a second is placed at a suitable distance from it, and semicircular platforms are made at each end, so that the whole may form a continuous railway, admitting of the car to pass round and round. The moulds are to be filled with tempered clay, and the loaded car passed over them, which fills them and smooths the upper surface of the brick. The bottom of each mould is capable of being raised up so as to deliver the brick; and to effect this, from each of these bottoms the end of a lever projects, which is acted upon by a lifter on the hind wheel of the pressing car, in a way described in the specification. The claim is to "the adaptation of the car and rail road to the manufacture of bricks, as set forth; and to the manner of raising the bricks out of the moulds."

40. For the *Application of latent heat to cooking, &c.*; Peter Wenn, an alien, who has declared his intention to become a citizen of the United States. Philadelphia, March 8.

It is a little surprising that a patent should be obtained for a contrivance so manifestly useless in an economical point of view, as it is scarcely to be expected that any number of persons would purchase what few would receive as a gift, on the condition that they should use it. Passing over the false philosophy of boiling, &c. by latent heat, we proceed to state that the apparatus consists of a tin case, into the lower part of which quick lime is to be put, and upon this cold water is to be allowed to run, when, by the slacking of the lime, a sufficient degree of heat is to be disengaged to boil, stew, &c. &c. The claim "is to boil water, to bake, heat, cook, and to dry substances *by means of latent heat*, evolved in the before described apparatus, without the aid of fire, flame, or radiant heat; and the manner in which the apparatus is to be used as aforesaid."

As a mere article of curiosity the thing was well enough, though scarcely fit for a "nine days' wonder." The idea of laying in quick lime enough for fuel, of discharging and vending the slacked lime, with all their concomitants, is one which no person, possessing judgment upon the subject, would entertain for a moment; and we dare aver that the patentee would not continue to use his own apparatus in his family, were the lime sent to him gratis.

41. For a *Steam boiler*; Job Carr, Springborough, Warren county, Ohio, March 12.

This boiler is intended to "generate a sufficient quantity of steam for propelling any kind of machinery, without any danger of bursting or collapsing." And a claim is made to the construction of the reservoir and furnaces, or improved steam generator, and agreement of the combined parts." What is meant by the *agreement of the combined parts*, we cannot tell, as we find nothing new in the whole affair, either individually, or collectively. The only provision to prevent bursting is staybolting through

the boiler, and banding it with iron on the outside. The boiler itself is to be wagon-shaped, and the furnaces are to be within it. We collect from the description, that in order to generate steam enough, there must be fire enough, and water enough, but more than this we cannot discover.

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42. For a *Washing machine*; Albion P. Arnold, Readfield, Kennebec county, Maine, March 12.

A double headed beater is made to vibrate in a trough in just the same way as in many other washing machines; and after giving the exact measures of the individual parts, the patentee claims "the fluted ends of the chest, the covering, the iron shaft and boxes, the steel spring and the lever on which it acts," to which might have been added "the washerwoman," if not previously claimed.

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43. For a *Forcing pump*; William W. Lesuer, Venice, Cayuga county, New York, March 12.

This is a double, cylinder pump, arranged very much in the manner of the double pumps of an ordinary fire engine, with the disadvantage, however, of changing the direction of the water as frequently, and as abruptly as could well be done. A tube, or pipe, is to descend from the bottom of the box containing the cylinders, into the well, or other source of supply. A claim is made to "the tube on the under side of the box, as applied to this machine; the form of the box and the manner in which it is connected with the cylinders, and tube on the bottom of the box."

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44. For a *Reaction water wheel*; Abraham Straub, Milton, Northumberland county, Pennsylvania, March 12.

This reaction wheel is to be in the form of a drum, or cylinder, like Wing's, and many others; but it is to have only two buckets, or floats, and two points of discharge; each bucket is to exceed a half circle, to allow their lapping over at the discharge orifices. The great point upon which the patentee depends, is the peculiar kind of curves which he gives to his two buckets, "the nature of which is such an involute as that its distance from its centre shall increase regularly and continually, thereby affording an uninterrupted discharge to the water, without any resistance being offered from the imperfections of shape found in those methods heretofore used." These involutes, or buckets, differ but little from segments of circles, and notwithstanding the applied mathematics of the patentee, we are fully convinced that were he to make his own wheel, and another in all respects similar, but with the buckets segments of circles, he would never, from their effects, discover the difference between the two. Every practical man knows to what a short distance theory will conduct him as a sure guide in hydraulic undertakings. We do not think it necessary to give the patentee's mode of describing his curve.

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
45. For a *Bed-bug destroyer*; Brittain Garrard, Maysville, Blount county, Tennessee.

Although three or four patents have been obtained for scalding bugs to death by steam, and although the kind of thing used for the purpose was well known prior to the obtaining of the first patent, it seems that there are yet some which have escaped destruction. The present patentee makes some change in the arrangement of his steam kettle, or boiler, rendering it

somewhat more complex, but we do not think more convenient, than heretofore. We shall not describe, as the patentee has not claimed, the alterations, or improvements, made in "the family safety scalding pot and steam engine."

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46. For a *Mantle and Fender for fire places*; Elijah Skinner, Sandwich, Stafford county, New Hampshire. First patented April 19th, 1822. Patent surrendered and reissued March 12.

Neither the original, nor the renewed, specification presents any claim, and the principal, we believe the only, difference between them, is that the description in the latter is less full and clear than that of the former. The mantle is to be of sheet, or of cast-iron, and projects out like a shelf, having a facing descending at right angles from it. The fender is to be a thing of sheet-iron, bent thus ; one edge of it going against the back of the chimney, and the other resting on the hearth, so as to cover the fuel and form a close stove. These affairs appear to be independent of each other, and ought, in this case, to have been the subject of two patents; we do not think, however, that the point is worth disputing.

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47. For a *Cooking Stove*; John Liddle, Schoharie, county of Schoharie, New York, March 12.

A furnace is to be surrounded by a rectangular chamber, furnished with doors, and intended either for baking, or boiling, having openings in its lower side, over the fire, to receive boilers; when used for baking, these openings are to be closed by a cast-iron slide. Each end of this chamber forms a flat flue, communicating with flues surrounding an oven which surmounts the chamber first named. As we are left to discover the novelties in this contrivance, by the entire omission of a claim, we shall transfer the task to the reader.

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48. For a *Cheap Lock*; Abel Conant, Lowell, Middlesex county, Massachusetts, March 12.

It so happens that this lock is not a lock, but merely a spring bolt, not a word being said about a key, or any contrivance for securing the bolt. The parts which are individually described, are, when put into their proper places, to form a mortise bolt, or fastening. The back part of the bolt, which occupies the interior of the box, is a quadrangular frame, which is forced back by means of a dog, or cam, in the usual way. A zigzag spring placed within the bolt, and bearing against the case of the tumbler and the front end of the hollow bolt, forces it forward. There are four individual claims, some of which, we apprehend, will not be sustainable. The first is to the cheap construction, which, as a result, may be very good, but as a claim is somewhat equivocal; the second, is to the transferring of a large portion of the chamfer of the bolt to the catch, thus allowing the bolt to be reduced in thickness—which must certainly abridge the distance to which the bolt will throw out, and produce some inconvenience. The third is to the application of the zigzag spring within the hollow of the bolt, and the fourth, "to the use of cast, or wrought iron, knobs, or handles, in place of glass, wood, brass, or other metal." In this last particular, there is neither invention, nor discovery, but a mere change of materials; the validity of which, as a foundation of a claim, we must doubt.

49. For a *Cast-iron Fire place*; William Burgess, Middleborough, Plymouth county, Massachusetts, March 12.

An open, cast-iron, fire place is to have two, or more, ovens, at the back of it. The fire place must project out into the room, as the openings into the oven are at each end. There are also to be openings between, and at the back of the ovens, forming flues around which the heated air may pass. The claim is to "the application of the oven and cooking apparatus, to the common open fire place, or frame, as above described." The contrivance here claimed, resembles many others, and is not distinguished from them by any thing presented in the specification.

50. For *Machinery for making Cap Wire*; Melville Kelsey, city of New York, March 12.

The claim made in this machine is to "the principle of using two, or more, bobbins at the same time, upon the same spindles, thereby turning off the work much faster." The wire passes through a hollow mandrel, or spindle, upon one end of which are the bobbins and flyers. The description of the machine is not by any means clear, nor is the drawing a very descriptive one, but still, we believe, that by a competent workman, the machine might be made with their aid.

51. For an improvement in *Piano Fortes*; Henry Hartge, city of Baltimore, March 12.

The improvement here claimed, consists in making the tuning block of a piano forte, in part of wood, and in part of iron, in a way which we believe to be new. The wooden tuning block may be covered with an iron plate three-eighths of an inch in thickness, and the holes for the tuning pins be bored through the iron, and into the wood. The iron plate prevents the pins from being drawn out of perpendicular by the tension of the strings, whilst the pin has the advantage of being kept from turning by the elasticity of the wood. The claim is to "the metallic plate fastened to the tuning block, with holes for the tuning pins to pass through, furnishing additional security and permanency to such pins, and giving increased firmness to the tuning block, thereby aiding to keep the instrument in tune." We have no doubt of the goodness of this contrivance, or of its superiority to the devices which have preceded it in instruments where frames in part, or wholly, of iron, have been used to sustain the tension of the strings.

52. For an improvement in *Capstans for Ships or other vessels*; Andrew Morse, Jr., Boston, Suffolk county, Massachusetts, March 12.

The main body of this capstan revolves upon a hollow shaft firmly fixed in the deck of the vessel, and is turned by handspikes, in the usual way. It has a cap fixed upon a stout iron shaft, which iron shaft passes through the hollow shaft first mentioned, and extends to the lower side of the deck, and there carries a spur wheel, which meshes into another spur wheel upon a second shaft which passes up through the deck. The upper end of this second shaft has also a small spur wheel upon it, which meshes into a large wheel surrounding, and firmly fixed to, the lower end of the capstan. The small spur wheel upon the second shaft may be thrown out of gear at pleasure. The usual palls, to prevent back motion are, of course, employed. When the small spur wheel is thrown out of gear, and the windlasses are made to turn the main body of the capstan, it operates

without any aid from the gearing; but when the small wheel is in gear, and the handspikes are applied to the cap, the power is increased in a degree dependent upon the proportionate sizes of the train of wheels.

"The invention here claimed, and desired to be secured by letters patent, is the improvement of the ships' or vessels' capstan, so that increased power may be obtained at pleasure, as above described; with the arrangement, application, and adaptation of the several parts as herein set forth."

At page 594, Vol. xvi., a capstan is described, which operates upon the same principle with the foregoing, although not under precisely the same arrangement; this was patented in May, 1835. One very similar was patented in England, in February, 1827, see Newton's Journal, 2nd series, vol. ii, p. 66. Another still more like in arrangement, and precisely similar in effect, was patented by Capt. Phillips, in England, in 1819, see Newton's Journal, vol. ii, p. 1. Other examples might be offered, but these, it is supposed, will suffice. We are aware that the patentee may point out variations from these, which he may deem important; but we cannot perceive any substantial difference between his plan and that of Capt. Phillips, or any change which might not have been made by an ordinary workman who had no claim to inventive talent.

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53. For a *Cotton Baling Press*; James C. Mitchell, Madison county, Mississippi, March 12.

In this press there are two followers, which, in pressing, are made to approach each other, by two shafts, each having a right handed screw cut on one end, and a left handed screw upon the other. The screws stand vertically, their upper ends revolving in collars in the cap of the press, and having spur wheels upon them above the cap. Their lower ends work in steps in the side of the press. The two followers have nuts let into them adapted to the screws. As this press is intended for baling cotton, there is a portion of each screw shaft, in the middle, which is left square, for nearly the thickness of a bale. A large spur wheel, on a vertical axis, turned by horse, or other, power, meshes into the wheels on the upper ends of the screw shafts, the right and left handed screws then cause the followers to approach, or recede, according to the direction in which they are turned.

The dimensions of the respective parts, and the appendages necessary for the packing of cotton, are sufficiently described in the specification. The construction of the press, with the exception of the wheels for working it, is claimed as entirely new.

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54. For a *Compound Lever Tooth Extractor*; Moses P. Hanson, Bangor, Penobscot county, Maine, March 12.

This instrument is the same in principle with others which have been made for the same purpose. The tooth is to be seized by forceps, and to be drawn by causing a part of the instrument to rest upon the adjoining teeth, or gums, to operate as a fulcrum in drawing the tooth. Many teeth could not be drawn by means of such an instrument, and it is always objectionable, as the teeth upon which the fulcrum rests must be forced in with a power equal to that required for extracting the one to be drawn. We have now a similar instrument in our possession, and have seen many others. A good forceps, or key, correct judgment, a firm grip, and a strong wrist, require no patent, nor any improvement.

55. For *Drying paper by the application of Dry Heat*; Henry P. Howe, Shirley, Middlesex county, Massachusetts, March 12.

In the manufactories where cylinder paper is made, the sheet is dried by means of large, iron cylinders, into which steam is admitted through a hollow gudgeon; but the present patentee places a furnace within his cylinder, instead of using steam. We are by no means convinced, however, that the plan which he proposes is a real improvement, although we cannot offer any decided opinion on the subject, as the construction and management of the furnace, and some other points, are obscurely presented, and there is not any thing claimed.

56. For *Forge Backs for Blacksmiths*; Charles Richardson, Greenfield, Hillsborough county, New Hampshire, March 12.

There have been numerous patents for hollow, cast-iron, forge backs, many of them marked by very slight differences. We do not, in the one before us, see any thing worthy of particular notice. The patentee claims a "spiral plate of cast-iron, and the peculiar form and size of the swelled front, or convex part in the front part of the box." The spiral plate is a partition to cause the admitted air to circulate, and to become heated prior to its exit.

57. For an improved *Steam Boiler for generating Steam, to be used in the drying of paper*; John Ames, Springfield, Hampden county, Massachusetts, March 12. See specification.

58. For a *Machine for making Butts and Hinges*; Welcome Whitaker, Troy, New York, March 12.

We can afford but little more than the claims preferred by the patentee of this machine, which is intended to bend sheet metal round the joint wire, so as to form the knuckles of hinges. The description, which occupies several sheets of paper, might have been abridged by making duplicate drawings, and referring to them by letters, or figures, and whilst it would have lost in length, it would have gained in distinctness. The drawing is a well executed perspective, but showing only one view of the machine.

The claims are to "the manner and principle of placing, holding, and supporting the wire round which the tongues of butts, or hinges, are to be bent and formed into eyes, together with the manner of securing the hinge for that operation. The manner and principle of bending the tongue round the wire, either by allowing the ends of the dogs to slide upon their surface, or by causing them to roll and not slide. And also the above described machine, and every part of it, together with the manner, and principle of its construction and operation, as therein combined, and as constituting a whole, and as specially applied to the purposes of bending the tongues of the butts and hinges, and forming them into eyes."

59. For a *Detacher, for detaching horses from carriages, &c.*; Philip T. Share, city of Baltimore, March 18.

Numerous patents have been obtained, both here and in Europe, for detaching horses from carriages, in case of their running away; and many of them are sufficiently simple and efficient, but they have not been kept in use, nor are they likely to be so. We have no fault to find with the contrivance before us, nor any praise to bestow upon it, as it does no

appear to be either better or worse than several of its predecessors. Sailors are proverbially averse to cork jackets, and other life-preservers, and other classes act, more or less, from the same kind of impulse; there is a feeling adverse to the constantly guarding against evils which are contingent, and are believed to be remote. Where by one act, like insuring against fire, the precaution is in its nature durable, prudent men will resort to it, but, otherwise, rarely. The contrivance which has become our text, will soon be forgotten, and be succeeded by analogous inventions, destined to share the same fate.

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60. For *the use of Gum Elastic in Corsets, Braces, &c.*; Ransom Warner, city of New York, March 18.

"I claim as my own invention, the application and introduction of gum elastic into the braces for the shoulders; for corsets; for men's and women's apparel; for suspenders; for the curved and distorted spine; for retaining the fracture of the collar bone in its place; and the applying of the gum elastic to the human system to supply artificial muscular power, so as to meet the antagonist muscle, or to supply strength to the weakened fellow muscles, in proportion to the necessity of the case, or as the contractile power may be required."

It is too late to claim the introduction of India rubber into braces, &c. &c., in the broad way in which it is claimed above, as it has been repeatedly used in webbing, and in other forms, for some of the purposes named. As regards several of these, we apprehend that its successful employment will baffle the skill of the patentee, although we should be glad to think otherwise.

(TO BE CONTINUED IN OUR NEXT.)

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NOTE. We have not noticed one half of the patents for the month of March, the whole number being 133; the remainder will be given in our next; this, we are aware, will throw us another month in arrear with our notices, which we intend shall usually follow six months after that in which the patents are dated. The diminished number issued immediately after the passing of the new law, will enable us to overtake the business, without giving an undue length to the article containing our animadversions, as would have been the case had we included the whole for the month of March, in the present number.

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#### SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a patent for an improved Boiler for generating steam.*  
Granted to JOHN AMES, Springfield, Hampden county, Massachusetts,  
March 12th, 1836.

To all whom it may concern, be it known, that I, John Ames, of Springfield, in the county of Hampden, and state of Massachusetts, have invented an improved boiler for the generating of steam, to be used in the drying of paper, and for other purposes, and do hereby declare that the following is a full and exact description thereof.

As this boiler is not intended to be used for steam of great elasticity, but is designed mainly, to produce it in large quantity, I intend, usually, to make it of cast-iron, although wrought-iron, or other metal, may be used if preferred. It may be made of various sizes, and in different shapes,

but for the sake of description, I will give the dimensions of one which I have tried, and found to answer well. It consists of a box four feet square, and two feet deep, the two sides being open, but furnished with flanges for the purpose of bolting on the two plates which are to form the two sides of the stove. Tubes, forming flues, in the manner of the boilers now in general use for locomotive engines, are to pass through these side plates. In the one alluded to, the plates are cast with six rows of holes, nine in each, and about two inches in diameter. The upper row of tubes must be sufficiently below the water line to insure their being constantly covered; and above the water there must, of course, be sufficient space to form a steam chamber, or reservoir.

When this boiler is set, the draught from the fire place below it passes through two rows of the tubes, is returned through the next two, and finally through the upper rows. The manner of forming the flue by divisions, extending from the brick work to the sides of the boiler, between the respective pairs of rows will be readily understood by reference to the drawing which accompanies this specification.

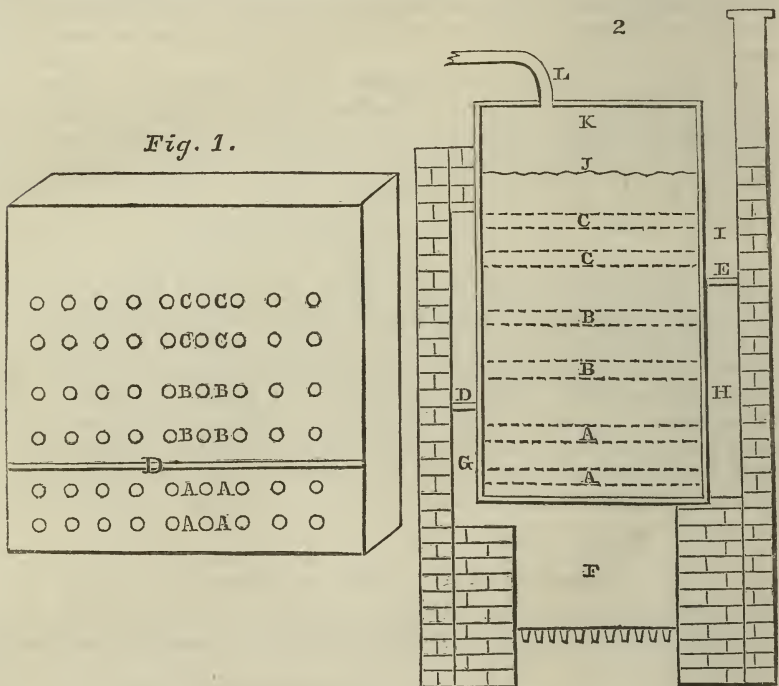


Fig. 1. is a side view of the boiler A A, B B, and C C, being the open ends of the tubes through which the heated air from the furnace is to pass, as will be shown more distinctly in fig. 2. D, is one of the ledges or partitions which project out from the boiler, occupying the space between it and the masonry in which the boiler is set, and causing the draught to enter the tubes A A, in order to its returning through those marked B B.

Fig. 2, is a vertical section of the boiler and furnace, cutting the boiler from front to back. A A, B B, and C C, are the double ranges of tubes,

as in fig. 1, represented by dotted lines. D and E, are partitions which direct the draught through the tubes in the following manner. Let F represent the furnace, and C a part of the flue into which the tubes A A, open, the draught being arrested by the partition D, will pass through A A, into the flue H, and being arrested by the partition E, will return through the tubes B B, then pass those marked C C, into the flue I, leading into a smoke pipe, or chimney; J, may represent the water line, K, the steam chamber, and L, the steam pipe.

Although I have mentioned a certain number of tubes, and have said that in the boiler which I have tried, the heated air is made to pass through the water three several times, it is manifest that the same operation may be repeated as frequently as it shall be found advantageous so to do. The number of tubes also, may be varied, and they may be placed in single rows, or otherwise, without altering the principle of action.

I have not mentioned the safety valves, cocks, or other general appendages to steam boilers, as in these I do not profess to have made any improvement; nor have I described any particular manner of securing the tubes, this being well known to engineers.

A boiler thus made, is recommended by its simplicity and economy, where it is desirable to generate a large quantity of steam under a moderate pressure, as for the purposes of heating and drying in various manufacturing processes. What I claim as my invention in it is the general combination and arrangement of the parts by which the draught from the fire is made to pass repeatedly through the water, as herein set forth, whether made in the exact form represented, or in any other which is substantially the same in its construction and operation.

JOHN AMES.

## Progress of Physical Science.

*On a new Force acting in the Formation of Organic Compounds.* By M. BERZELIUS. (*Jahrbuch de Schumacher*, for 1836).

When new compounds are produced in inorganic nature as the result of the reaction of different bodies, it is in consequence of a mutual tendency of those bodies to satisfy the laws of their affinity in a more complete manner. First, the substances possessing dominant affinities enter into combination, and then those of feeble affinities which were excluded from the first combination. Before the year 1800, the existence, in these phenomena, of any other determining cause than the degree of affinity, heat, and, in some cases, light, was scarcely suspected. The influence of electricity was then discovered, and we soon saw ourselves in danger of confounding the electrical with the chemical relations of bodies, and of considering their affinities only as the manifestation of a strong electrical contrast, increased by light and heat. This system offered no other means of explaining the origin of a new compound, than by the supposition, that, by the approximation of bodies which are present, their electrical states become neutralized in a more perfect manner.

Setting off from these ideas, deduced from the effects which occur in inorganic nature, and studying the chemical re-actions presented by organized bodies, we perceived that in the organs of the latter, substances the

most various were elaborated, while the brute matter, whence they proceeded, consisted, in general, of but one liquid, circulating in vessels with more or less velocity. The vessels of the animal body, for example, pump blood from their origin without interruption, and nevertheless, secrete milk, bile, urine, &c. at their extremities, without admitting any other liquid capable of producing, by double affinity, any decomposition whatever. A fact here evidently occurs, which the study of inorganic nature was then unable to explain.

At this period M. Kirchhoff observed that starch dissolved in diluted acid, became converted, at a certain temperature, first into gum, and afterwards into grape-sugar. In conformity with the principles then received with regard to effects of this kind, an endeavour was made to ascertain what the acid had removed from the starch to reduce it into sugar; but no gas had been disengaged, the acid re-appearing by means of the alkalis in its primitive quantity, had not been combined, and the liquid contained only sugar in an equal, or even a larger, quantity than the starch which had been employed. The cause of this alteration was as problematical as that of the secretions in the organic body. M. Thénard then discovered the peroxide of hydrogen, a liquid, the elements of which are retained in combination by a very weak affinity. The acids do not produce any alteration in it; the alkalis, on the contrary, produce in it a tendency to decomposition, a species of fermentation, which reproduces water, in consequence of a disengagement of oxygen. But the most interesting circumstance, is, that the same effect takes place from the action of different solid bodies insoluble in water, organic as well as inorganic; for example, from the presence of peroxide of manganese, of silver, platinum, and also the fibrin of animal blood. The body which determines the decomposition does not undergo any alteration, it does not act as an element of a new compound, but by virtue of a peculiar force inherent in its mass, the existence of which, though unknown in its essence, is demonstrated by its effects. Shortly before M. Thénard, Sir H. Davy remarked another phænomenon, the analogy of which with the one just described, was not immediately perceived. He had proved that platinum, heated to a certain degree, and brought into contact with a mixture of the vapour of alcohol, or ether, and atmospheric air, possessed the power of determining and sustaining the combination of these bodies, while gold and silver were devoid of this property. Soon after, Mr. E. Davy discovered a preparation of platinum in a state of very great mechanical division, having, at ordinary temperatures, and after having been moistened with alcohol, the property of becoming incandescent by the combustion of alcohol, altogether in converting it by oxidation, into acetic acid. Then followed the discovery of Döbereiner, the most important of all. He proved that it is the property of spongy platinum to inflame, spontaneously, a current of hydrogen gas projected in the air; a phenomenon which the researches of M. M. Thénard and Dulong proved is produced by several other bodies, simple as well as compound: with this restriction, however, that while platinum, iridium, and some other platinal metals, act at temperatures below zero, other bodies, such as gold, and more especially silver, require a much higher temperature, and glass a heat even of above 300°. Thus what was at first considered as an exceptive mode of action, appeared to be a general property, though variously graduated, of all bodies, and from the application of which, advantage might be derived. We know, for example, that in the act of fermentation, in the conversion of sugar into alcohol and carbonic acid, the

action exercised by the insoluble substance named leaven, and which may be replaced, though with less success, by animal fibrin, albumen, and caseous substances, &c., cannot be explained by any chemical reaction of the affinities of the sugar and the leaven, and that no effect in inorganic nature approaches it so nearly as the action of platinum, silver, or fibrin in the decomposition of the peroxide of hydrogen into oxygen and water. It was natural here to suppose an analogous mode of action. The conversion of starch into sugar, by means of sulphuric acid, had not yet been co-ordinated with the preceding facts; the discovery, however, of diastase (announced in the Annual Report for 1833), a substance acting upon starch in an analogous manner, only with more energy, directed attention to this analogy, which was definitively proved by the ingenious researches of M. Mitscherlich upon the formation of ether. Among the numerous theories upon the formation of ethers, one, we know, makes the property of sulphuric acid to convert alcohol into ether, to depend upon its power of absorbing water, granting, that the alcohol, considered as a compound of one atom of etherine ( $C^4 H^8$ ), and of two atoms of water, is reduced into ether, by ceding the half of its water to the acid. This theory, equally simple and ingenious, was in perfect agreement with our knowledge of the reaction of the affinities of bodies; it did not, however, explain why other bodies, not acids, having equal avidity for water, could not be employed in the same manner; why soda, potash, chloride of potassium, anhydrous lime, &c., if the transformation really depended only upon an affinity for water, did not equally produce ether. The researches of M. Mitscherlich proved that sulphuric acid, sufficiently diluted, and taken at such a temperature that the refrigeration produced by the addition of the alcohol, compensated for the heating which arose from the mixture, decomposed the alcohol into ether and water, which, because the temperature exceeded the temperature of ebullition of water, were both separated by distillation from the mass, and, as soon as the condensation was complete, presented a mixture of the same weight as that of the alcohol employed. The manner of performing this experiment, as well as the fact of the distillation of water conjointly with alcohol, was, it is true, known before M. Mitscherlich, but to him belongs the merit of having predicted its consequences. In fact, he proved that at this temperature, sulphuric acid must act upon alcohol by virtue of the same force which determines the action of the alkalis upon oxygenated water, since the water being entirely separated from the mixture, did not obey an affinity for the acid; whence he concluded, that the action of sulphuric acid and diastase upon starch, from which resulted the sugar, must be of the same nature.

It is then proved that many substances, simple or compound, solid or in solution, have the property of exercising an influence upon compound bodies essentially distinct from chemical affinity, an influence which consists in the production of a displacement, and a different arrangement, of their elements, without participating in it directly and necessarily, except in a few special cases. Certainly a force such as this, capable of producing chemical reactions in inorganic nature, as well as in organized bodies, though at present too little understood to be well explained, must exercise a more important function in nature than has hitherto been supposed. In defining it as a new force, I am far from wishing to deny that a certain connexion exists between it and the electro-chemical relations of matter. I am, on the contrary, strongly disposed to recognize in it a decided manifestation of these relations; nevertheless, till we have penetrated into the

real nature of this force, it will be more simple in our future researches to consider it as independent, and to give it, for facility of recognition, a name peculiar to itself. According to an etymology well known in chemistry, I shall consequently name it the CATALYTIC FORCE of bodies, and the decomposition which it determines *catalysis*, in the same manner as the separation of the elements of a compound, by means of the usual chemical affinities, is called *analysis*. This force may be defined to be *a power of bodies to bring into activity, by their simple presence, and without participating in it chemically, certain affinities, which at that temperature would remain inactive, so as to determine, in consequence of a new distribution of the elements of the compound, a new state of perfect chemical neutralization.* As this force acts in general in a manner analogous to heat, it may be inquired whether being variously graduated, sometimes by employing differently the same catalytic body, sometimes by the introduction of various catalytic bodies in the same liquid, it will cause, as is often observed in the action of heat at different temperatures, different catalytic products,—whether the catalytic force of a body can be exerted over a large number of compounds, or whether, as our experiments appear to indicate, only over certain bodies, to the exception of certain other bodies? But in the present state of our knowledge it is impossible to decide these questions, and many others that might be proposed upon the subject: their solution must depend on the results of future investigations. It is enough, for the present, to have shown, by a sufficient number of examples, the existence of this force, which, defined as it has been, diffuses a new light over the chemical reactions of organized bodies. We shall cite but one example. There is an accumulation of diastase around the eye of the potatoe, which is not found in the tubercle or in the developed germ; we perceive in this point a centre of catalytic action, at which the insoluble starch of the tubercle is converted into gum and sugar, and this part of the potatoe will become the secreting organ for the soluble substances, which are to form the juices of the growing germ. It is not probable that the action mentioned is the only one of its kind in vegetable life; on the contrary, it may be presumed, that in vegetables, as well as in the animal body, a thousand catalytic effects take place between the tissues and the liquids, whence results the great number of different chemical compounds, the production of which, from the same brute matter, which we call blood, or vegetable juices, cannot be explained by any other known cause.—*Bibliothèque Universelle, Nouv. Ser. Tome ii., p. 376.*

A. T.

Rep. Pat. Invent. Aug.

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#### *Sixth Meeting of the British Association for the Advancement of Science.*

The Annual Sessions of this Association were commenced by a meeting of the General Committee, at Bristol, on Saturday, August 20, and were continued throughout the following week. The arrangement was, that the Sections should meet at eleven o'clock every day during the week, and that the General meetings of the Association should be held at 8 o'clock on the evenings of Monday, Wednesday and Friday. The concluding meeting to take place on Saturday, at an hour fixed by the General Committee. Several public dinners were given, and an ordinary was provided daily, at the Horticultural rooms, for strangers, at 5s. per head. The number of members in attendance exceeded that of any previous meeting,

and amounted to about 1350. The business of the Association is conducted by several Committees and Sections, as follows:

Section A. *Mathematical and Physical Science.*

President, REV. W. WHEWELL.

B. *Chemistry and Meteorology.*

President, REV. PROF. CUMMING.

C. *Geology and Geography.*

President, REV. DR. BUCKLAND.

D. *Zoology and Botany.*

President, PROF. HENSLow.

E. *Anatomy and Medicine.*

President, DR. ROGET.

F. *Statistics.*

President, SIR CHARLES LEMON, *Bart.*

G. *Mechanical Science.*

President, DAVIES GILBERT, Esq.

The President of the Association was the Marquis of Landsdowne, who was prevented from attending by the illness of his eldest son, the Earl of Kerry, who died during the week of the Sessions. The chair was taken by the Marquis of Northampton, one of the Vice Presidents.

The business of the week appears not to have been excelled, in point of interest, by that of any prior meeting of the Association. Most of the British Savans whose names are well known throughout the scientific world, were present, except that among those whose names now occur to us, and which we do not find in the list of attendants, are Faraday, Airy, and some others. Among the learned strangers, were Baron Dupin of the French Institute, and Dr. Hare of Philadelphia. The latter was elected one of the Committee of Section B. His several communications were evidently received with most respectful attention, and at the public dinner, where nearly 500 persons were present, we find him on the right of the chair next to Prof. Whewell.

"The interest excited throughout the week, (observes the correspondent of the London Athenæum,) cannot be conceived by those who were not present. The mass of interesting matter brought forward was quite unexpected. Prof. Sedgwick said that the present meeting was worth all previous ones put together—that now the British Association was really advancing Science, all the branches of which were becoming more and more connected with each other. The new views of Physical Science brought forward at the Geological Section, were the most important advances yet made in Geology. This would gradually be numbered among those branches of knowledge under the dominion of mathematical laws, and be eventually placed in the same ranks with her kindred sister Astronomy."

The sum devoted to scientific enquiries during the ensuing year exceeds £2700! The next meeting of the Association is to be held at Liverpool, rather later in the year than the present; the day to be fixed by the General Committee.

The office bearers chosen for the meeting in 1837, are the Earl of Burlington, President; Dr. Dalton, Sir Philip Egerton, Rev. E. G. Stanley, Vice Presidents; Dr. Charles Henry, Mr. Parker, Secretaries.

Our extracts from the published accounts of the various matters brought forward in the different Sections must, necessarily, be limited to a few of those that appear to possess the greatest novelty and interest.

*Change in the Chemical character of Minerals induced by Galvanism.* By R. W. Fox. This communication was from a gentleman long known in connexion with Science, and largely connected with the mining districts of Cornwall. Nothing which occurred at the meeting appears to have produced a higher interest than this communication, and the one which immediately followed.

Mr. Fox exhibited the extraordinary experiment of the change of yellow into the grey sulphuret of copper. In a trough a mass of clay was placed so as to divide it into two portions, in one of which was sulphate of copper in solution, in the other dilute sulphuric acid. On the electric communication being made by placing the yellow sulphuret in the solution, and a piece of zinc in the acid, the change of the sulphuret took place, and crystals of native copper were also formed upon it.

Mr. Fox then made some remarks upon the electro-magnetism of veins. It was plain that when a rock contained mineral matter, the rock and its contents must be in different electrical states, so that electricity must exist in very great activity in the interior of the globe. He referred to his experiments recorded in the Transactions of the Geological Society. He alluded to the north-east and south-west directions of the Cornish veins, and he had ascertained that there are Voltaic currents perpendicular to the magnetic meridian. Tin is found to exist in veins, or in different parts of the same vein; and, in experimenting, he found that metallic tin went to the positive, and oxide of tin to the negative pole of the apparatus. He was also struck with a kind of polarization in the disposition of the matter of veins; thus, iron and copper presented distinct relations to each other; the grey sulphuret of copper was uniformly found above the yellow; the quartz of N. and S. veins were striated, that of E. and W. veins not so. The phenomena of the intersection of veins were also spoken of; the old supposition, that one vein must be older than the other, need not be resorted to in all cases, as it could be proved that crossing veins were often of simultaneous origin.—Dr. Buckland pointed out Mr. Fox's experiment as an illustration of the simplicity of the means which nature had adopted in her most subtle operations, and expressed his hope that this new application of electro-chemistry to geology, would furnish a series of results of paramount importance. Indeed, one of the great benefits conferred by the British Association on science, was the bringing forward individuals who had devoted themselves in private, to scientific investigation and experiment, which often, as in the case of Mr. Fox, opened the portals that led to new views of nature and her operations. He had now to introduce to the notice of the Section another gentleman, who had for many years, in private seclusion, occupied himself in experiments of a novel and extraordinary character, and also making use of apparatus of the most simple description. He then presented to the notice of the meeting, Mr. Cross, who would give a verbal account of his most singular proceedings.

*Artificial Crystals and Minerals.* A. Cross, Esq. of Bloomfield, Somerset, then came forward and stated that he came to Bristol to be a listener only, and with no idea that he should be called upon to address a Section. He was no geologist, and but in a moderate degree a mineralogist. But, being early impressed with the notion that it would be desirable to produce, if possible, a long continued, undiminished electrical action, he had set himself to work, and after many trials he had constructed an apparatus, which had for no less than an *entire year* retained its electric energy, and

this by the agency of pure water only. He had also conceived, that it being by long continued processes that nature produced most of the effects which we observe, it might be possible to form substances similar to what she affords, by adopting a mode like hers. His attention had been directed to a cavern in the Quantock Hills, in which he had observed calcareous spar incrustated on limestone, and arragonite on clay slate: these minerals had evidently been formed by the water which percolated the rocks. Some of this water he brought to his house, and presented it to the action of his Voltaic apparatus; for nine days he anxiously watched for a result, but no visible one offering, he had almost given up the experiment, when on the tenth day, to his great delight, he succeeded in procuring minerals the same as in the cavern. He was thus encouraged to prosecute further experiments; and, in the course of his investigations, he found that light was unfavourable to the perfection of crystals, he being enabled, in a much shorter period, and with much weaker electric power, to produce them in the dark. He formed several crystals of metallic minerals, but his most successful experiment was the production of quartz from fluo-silicic acid, and his inspection of what has been perhaps never before observed by mortal eye, the process of crystalline developement from the beginning. He had traced a quartz crystal, first, as a hexagon marked upon the matrix—then lines radiated from its centre—then parallel lines were formed parallel to its sides—it increased in thickness, but, owing to some disturbance of the operation, the process of forming a single perfect crystal was not completed, for a second crystal grew up and intersected it, offering an additional confirmation of the resemblance of Mr. Cross's process to that of nature, where this penetration of crystals into each other is every where to be observed.

It would be extending this report too far to relate all that Mr. Cross communicated to the Section regarding the details of his experiments; but it is impossible to convey an idea of the enthusiasm with which his statement was received by the crowded assembly present. There appeared to be a real *electrical* effect produced upon them; they seemed as if the interior recesses of Nature had been of a sudden laid open to them, and her processes, which had been conceived as past all mortal ken, submitted to their inspection. Mr. Cross was often interrupted during his address with loud peals of applause, which lasted for several minutes after he sat down.—Mr. Conybeare said, that he found himself so excited with the intelligence, that he should not submit his observations on the South Wales Coal Basin; he considered any communication he could bring forward totally eclipsed in interest by the overpowering intelligence brought by Mr. Cross. Upon that gentleman Mr. Sedgwick passed also a highly eloquent eulogium. Professor Phillips stated, that he had now hopes of realizing his fondest dreams of geology. He had long conceived that Nature must have some means of conveying solid matter through solid matter, and that this was now proved by Mr. Cross, whose discoveries were of such importance, that had the British Association been of no other service than in bringing them to light, they alone were worth all the pains it had taken for the advancement of science, and it was its particular business to have experiments like his set on foot, and prosecuted for many years to come.

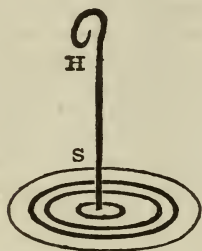
It was mentioned to the Section on the following day, that although no doubt could be entertained of the independence and originality of Mr. Cross's experiments, yet that he had been anticipated in the artificial production of many of the crystalized bodies which he had formed, by M. Becquerel and some other French Chemists.

*Improvements on the Electrical Apparatus for Dancing-Images.*

When the plates are not of considerable size the images leap off, and if very large the view is obstructed. To obviate these difficulties, plates of glass are recommended by W. Ettrick, with bands of tin foil pasted in corresponding positions on each side. In fig. 1,  $a' b' c'$ , and  $xy z$ , and  $a' a$ , represent

Fig. 2.

Fig. 1.



pieces of tinfoil pasted on each side of the glass; a hole  $P$  being cut in the centre of the glass to pass the tinfoil  $a a'$  through, and thereby connect the metallic circular slips. In fig. 2, the rod and crook  $S H$  represents the suspending wire, which is screwed into a circular flat piece of brass, upon which the glass plate lies. The slips or rings of tinfoil do not come close to the edge of the glass, which greatly assists in keeping the figures upon the plates, because they will generally touch the tinfoil, as being more charged than the glass. If a similar glass plate be used for the lower plate, it would be a further improvement. *Lond. Mech. Mag.*

**Progress of Practical and Theoretical Mechanics and Chemistry.**

*Method of separating small quantities of Arsenic from substances with which it may have been mixed.* By MR. JAMES MARSH, of the Royal Arsenal, Woolwich.\*

Notwithstanding the improved methods that have of late been invented of detecting the presence of small quantities of arsenic in the food, in the contents of the stomach, and mixed with various other animal and vegetable matters, a process was still wanting for separating it expeditiously and commodiously, and presenting it in a pure unequivocal form for examination by the appropriate tests. Such a process should be capable of detecting arsenic not only in its usual state of white arsenic or arsenious acid, but likewise that of arsenic acid, and of all the compound salts formed by the union of either of these acids with alkaline substances. It ought, also, to exhibit the arsenic in its reguline or metallic state, free from the ambiguity which is sometimes caused by the use of carbonaceous reducing fluxes. It appeared to me, that these objects might be attained by presenting to the arsenic hydrogen gas in its nascent state: the first action of which would be to deoxygenate the arsenic; and the next, to combine with the arsenic, thus deoxygenated, into the well known gas called arsenuretted hydrogen. Being thus brought to the gaseous state, the arsenic would spontaneously (so to speak) separate itself from the liquor in which it was before dissolved,

\* Received by the Franklin Institute in a pamphlet from London.

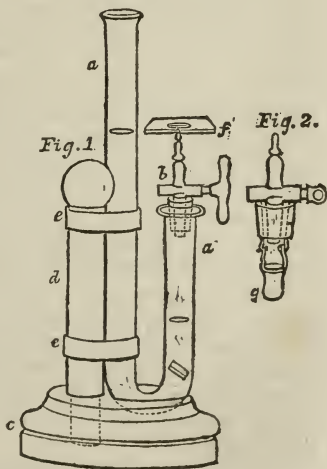
and might be collected for examination by means of any common gas apparatus; thus avoiding the trouble, difficulty, and ambiguity of clarification and other processes whereby liquors, suspected of containing arsenic, are prepared for the exhibition of the usual tests, or of evaporation and deflagration which are sometimes had recourse to, in order to separate the arsenic from the organic substances with which it may have been mixed.

I had the satisfaction of finding, on trial, that my anticipations were realized; and that I was thus able, not only to separate very minute quantities of arsenic from gruel, soup, porter, coffee, and other alimentary liquors, but that, by continuing the process a sufficient length of time, I could eliminate the whole of the arsenic in the state of arsenuretted hydrogen, either pure, or at most, only mixed with an excess of hydrogen.

If this gas be set fire to as it issues from the end of a jet of fine bore into the common air, the hydrogen, as the more combustible ingredient, will burn first, and will produce aqueous vapour, while the arsenic will be deposited either in the metallic state, or in that of arsenious acid, according as it is exposed partially or freely to the air. The former condition is brought about by holding a piece of cold window glass opposite to and in contact with the flame, when a thin metallic film will be immediately deposited on its surface; and the latter, by receiving the flame within a glass tube open at both ends, which, in half a minute, will be found to be dimmed by a white pulverulent sublimate of arsenious acid. By directing the flame obliquely within side of the tube, it strikes against the glass and deposits the arsenic partly in the metallic state. In this case, if the tube, while still warm, be held to the nose, that peculiar odour, somewhat resembling garlic, which is one of the characteristic tests of arsenic, will be perceived. Arsenuretted hydrogen itself has precisely the same odour, but considerable caution should be used in smelling to it, as every cubic inch contains about a quarter of a grain of arsenic.

The requisite apparatus is as simple as possible, being a glass tube open at both ends, and about three quarters of an inch in its internal diameter. It is bent into the form of a syphon ( $a'a$ , fig. 1), the shorter leg being about five inches, and the longer about eight inches in length. A stop-cock  $b$ , ending in a jet of fine bore, passes tightly through a hole made in the axis of a soft and sound cork, which fits air-tight into the opening of the lower bend of the tube, and may be further secured, if requisite, by a little common turpentine lute. To fix the apparatus, when in use, in an upright position, a hole is made in the wooden block  $c$ , for the reception of the lower part of the pillar  $d$ , and a groove is cut in the top of the same block to receive the bend of the tube  $a a$ . Two elastic slips  $e e$ , cut from the neck of a common bottle of India rubber, keep the tube firm in its place.

The matter to be submitted to examination, and supposed to contain arsenic, if not in the fluid state, such as pastry, pudding, or bread, &c., must be boiled with two or three fluid ounces of clean water, for a sufficient length of time.



The mixture so obtained must then be thrown on a filter to separate the more solid parts: thick soup, or the contents of the stomach, may be diluted with water and also filtered; but water-gruel, wine, spirits, or any kind of malt liquor and such like, or tea, coffee, cocoa, &c., can be operated on without any previous process.

When the apparatus is to be used, a bit of glass rod, about an inch long, is to be dropped into the shorter leg, and this is to be followed by a piece of clean sheet zinc, about an inch and a half long and half an inch wide, bent double, so that it will run down the tube till it is stopped by the piece of glass rod first put in. The stop-cock and jet are now to be inserted, and the handle is to be turned so as to leave the cock open. The fluid to be examined, having been previously mixed with from a drachm and a half to three drachms of dilute sulphuric acid (1 acid and 7 water,) is to be poured into the long leg, till it stands in the short one about a quarter of an inch below the bottom of the cork. Bubbles of gas will soon be seen to rise from the zinc, which are pure hydrogen if no arsenic be present; but, if the liquor holds arsenic in any form of solution, the gas will be arsenuretted hydrogen. The first portions are to be allowed to escape, in order that they may carry with them the small quantity of common air left in the apparatus; after which the cock is to be closed, and the gas will be found to accumulate in the shorter leg, driving the fluid up the longer one, till the liquor has descended in the short leg below the piece of zinc, when all further production of gas will cease. There is thus obtained a portion of gas subject to the pressure of a column of fluid of from seven to eight inches high: when, therefore, the stop-cock is opened, the gas will be propelled with some force through the jet, and, on igniting it as it issues (which must be done quickly by an assistant,) and then holding horizontally a piece of crown or window glass (*f*, fig. 1) over it, in such a manner as to retard slightly the combustion, the arsenic (if any be present) will be found deposited in the metallic state on the glass; the oxygen of the atmosphere being employed in oxydizing the hydrogen only during the process. If no arsenic be present, then the jet of the flame as it issues has a very different appearance; and, although the glass becomes dulled in the first instance by the deposition of the newly formed water, yet such is the heat produced, that in a few seconds it becomes perfectly clear, and frequently flies to pieces.

If the object be to obtain the arsenic in the form of arsenious acid, or white arsenic, then a glass tube, from a quarter to half an inch in diameter (or according to the size of the jet of flame,) and eight or ten inches in length, is to be held vertically over the burning jet of gas, in such a manner that the gas may undergo perfect combustion, and that the arsenic combined with it may become sufficiently oxydized; the tube will thus, with proper care, become lined with arsenious acid in proportion to the quantity originally contained in the mixture.

When the glass tube is held at an angle of about forty-five degrees over the jet of flame, three very good indications of the presence of arsenic may be obtained at one operation; viz. metallic arsenic will be found deposited in the tube at the part nearest where the flame impinges,—white arsenic or arsenious acid at a short distance from it,—and the garlic smell can be readily detected at either end of the tube in which the experiment has been made.

As the gas produced during the operation is consumed, the acid mixture falls into the short limb of the tube, and is thus again brought into contact with the

zinc, in consequence of which a fresh supply is soon obtained. This gas, if submitted to either of the processes before described, will give fresh indications of the presence of the arsenic which the mixture may have originally contained; and it may be easily perceived that the process will be repeated as often as may be required, at the will of the operator, till no further proofs can be obtained.

When certain mixed or compound liquors are operated on in this apparatus, a great quantity of froth is thrown up into the tube, which may cause a little embarrassment by choking the jet. I have found this effect to take place most with the contents of the stomach, with wine, porter, tea, coffee, or soup, and, indeed, with all mucilaginous and albuminous mixtures. The means I adopt to prevent this effect from taking place, or, at least, for checking it in a great measure, is to grease or oil the interior of the short limb of the apparatus before introducing the substance to be examined, or to put a few drops of alcohol or sweet oil on its surface previously to introducing the stop-cock and its appendages. I have, however, found, if the tube be ever so full of froth in the first instance, that, in an hour or two, if left to itself, the bubbles burst, and the interior of the tube becomes clear without at all effecting the results.

In cases where only a small quantity of the matter to be examined can be obtained, I have found a great convenience in using the small glass bucket, (g, fig. 2). Under such circumstances, the bent glass tube may be filled up to within an inch of the short end with common water, so as to allow room for the glass bucket, which must be attached to the cork, &c. by means of a little platina wire; a bit or two of zinc is to be dropped into the bucket, with a small portion of the matter to be examined, and three or four drops of diluted sulphuric acid; (acid 2, water 14,) and the whole is then to be introduced into the mouth of the short limb of the tube. The production of gas under this arrangement is much slower, and, of course, requires more time to fill the tube, than in the former case, but the mode of operating is precisely the same. Indeed, it is of great advantage, when the quantity of arsenic present is very minute, not to allow the hydrogen to be evolved too quickly, in order to give it time to take up the arsenic.

A slender glass funnel will be found of service when as much as a table-spoonful, or even a tea-spoonful of matter, can be obtained for examination. In this case, the tube is to be partly filled with common water, leaving a sufficient space for the substance to be examined; a piece of zinc is to be suspended from the cork by a thread or wire, so as hang in the axis of the tube; and the fluid to be operated on, having previously been mixed with dilute sulphuric acid, is then to be poured through the funnel carefully, so as to surround the zinc, avoiding, as far as possible, to mix it with the water below, and the stop-cock and its appendages are to be replaced in the mouth of the tube; the production of the gas then goes on as before stated, and the mode of manipulating with it, is exactly the same as described in the foregoing part of this paper.

It will be necessary for me, in this place, to explain the methods I employ after each operation, to determine the integrity of the instrument, so as to satisfy myself that no arsenic remains adhering to the inside of the tube, or to the cork and its appendages, before I employ it for another operation.

After washing the apparatus with clean water, a piece of zinc may be dropped in, and the tube filled to within half an inch of the top of the short limb; two drachms of diluted sulphuric acid are then to be poured in, and the stop-cock and cork secured in its place; hydrogen gas will in this case,

as before, be liberated, and fill the tube. If the gas as it issues from the jet be then inflamed, and a piece of window glass held over it as before described, and any arsenic remains, it will be rendered evident by being deposited on the glass; if so, this operation must be repeated till the glass remains perfectly clean, after having been exposed to the action of the gas.

When I have had an opportunity of working with so large a quantity of mixture as from two to four pints, (imperial measure) I have employed the instrument (fig. 3), which is, indeed, but a slight modification of one of the instantaneous light apparatuses, now so well known and used for obtaining fire by the aid of a stream of hydrogen gas thrown on spongy platinum. It will, therefore, be of importance only for me to describe the alteration which I make when I employ it for the purpose of detecting arsenic. In the first place, I must observe, that the outer vessel *a*, which I use, holds full four pints, and that the jet of the stop-cock is vertical, and its orifice is twice or three times larger than in the instrument as generally made for sale, and also that there is a thread or wire attached to the cork of the stop-cock *b*, for suspending a piece of zinc *c*, within the bell glass.

Fig. 3.

With an instrument of this description, I have operated on one grain of arsenic in twenty-eight thousand grains of water (or four imperial pints), and have obtained therefrom, upwards of one hundred distinct metallic arsenical crusts.

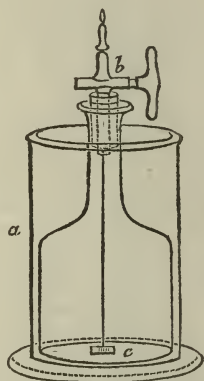
Similar results have been obtained with perfect success from three pints of very thick soup, the same quantity of port wine, porter, gruel, tea, coffee, &c. &c.

It must, however, be understood, that the process, was allowed to proceed but slowly, and that it required several days before the mixture used ceased to give indication of the presence of arsenic, and also, a much larger portion of zinc and sulphuric acid was employed from time to time, than when working with the small bent tube apparatus, in consequence of the large quantity of matter operated on under this arrangement.

With the small apparatus, I have obtained distinct metallic crusts, when operating on so small a quantity as one drop of Fowler's solution of arsenic, which only contains one-120th part of a grain.

The presence of arsenic in artificial orpiment and realgar, in Scheele's green, and in the sulphuret of antimony, may be readily shown by this process, when not more than half a grain of any of those compounds is employed.

In conclusion, I beg to remark, that although the instruments I have now finished describing, are the form I prefer to all that I have employed, yet it must be perfectly evident to any one, that many very simple arrangements might be contrived. Indeed, I may say unequivocally, that there is no town or village in which sulphuric acid and zinc can be obtained, but every house would furnish to the ingenious experimentalist ample means for his purpose; for, a two-ounce phial, with a cork and piece of tobacco-pipe, or a bladder, with the same arrangement fixed to its mouth, might, in cases of extreme necessity, be employed with success, as I have repeatedly done for this purpose.



The only ambiguity that can possibly arise in the mode of operating above described, arises from the circumstance, that some samples of the zinc of commerce themselves contain arsenic; and such, when acted on by dilute sulphuric acid gave out arsenuretted hydrogen. It is, therefore, necessary for the operator to be certain of the purity of the zinc which he employs, and this is easily done by putting a bit of it into the apparatus, with only some dilute sulphuric acid; the gas thus obtained is to be set fire to as it issues from the jet; and if no metallic film is deposited on the bit of flat glass, and no white sublimate within the open tube, the zinc may be regarded as in a fit state for use.

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*Method of determining the value of Black Oxide of Manganese for manufacturing purposes.* By THOMAS THOMSON, M. D., F. R. S., L. and E. Regius Professor of Chemistry in the University of Glasgow.

The manganese to be tested must be reduced to a fine powder, or brought into the state in which it is used by the manufacturers of bleaching-powder. To determine its value, proceed in the following manner:

Into a balanced Florence flask put 600 grains of water, and 75 grains of crystals of oxalic acid. Then add 50 grains of the manganese to be tested; and, as quickly as possible, pour into the flask from 150 to 200 grains of concentrated sulphuric acid. This is best done by having a given weight of sulphuric acid, say 210 grains, previously weighed out in a glass measure, counterpoised on one of the scales of a balance. You pour into the flask as much of the sulphuric acid as you can conveniently. Then, putting the measure again into the scale, you determine exactly how much has been put in.

A lively effervescence takes place, and carbonic acid gas is disengaged in abundance. Cover the mouth of the flask with paper, and leave it for twenty-four hours; then weigh it again. The loss of weight which the flask has sustained is exactly equal to the quantity of *binocide* of manganese in the powder examined. Thus, let the loss of weight be 34 grains; the quantity of binocide of manganese in the 50 grains of the powder which was tested will be 34 grains; or it will contain 68 per cent. of pure binocide of manganese, and 32 per cent. of impurity.

To understand what takes place, it is necessary to recollect that oxalic acid is composed of

2 atoms carbon	1.5
3 atoms oxygen	3
	<hr/>
	4.5

and that of binocide of manganese is composed of

1 atom manganese	3.5
2 atoms oxygen	2
	<hr/>
	5.5

The oxalic acid acts on the binocide by abstracting one-half of its oxygen, which converts it into carbonic acid; hence the effervescence. 55 grains of pure binocide of manganese would give out 10 grains of oxygen, which would convert 45 grains of oxalic acid into 55 grains of carbonic acid; which escaping, indicate, by the loss of weight, the quantity of carbonic acid formed. Now, it happens that the weight of the carbonic acid formed is exactly equal to the quantity of binocide of manganese which

gives out its oxygen to the oxalic acid. Hence the reason of the accuracy of the test.

In other words, an integral particle of binoxide of manganese, which weighs 5.5, gives out 1 atom of oxygen. This atom of oxygen combines with an integrant particle of oxalic acid, weighing 4.5, and converts it into two integrant particles of carbonic acid, which both together weigh 5.5. As this carbonic acid escapes, the loss of weight must be just equal to the quantity of binoxide of manganese in the powder subjected to experiment.

In practice, I find that a small quantity of the binoxide of manganese sometimes escapes the action of the oxalic acid, being probably screened by the great quantity of impurity with which it is mixed. But the deficiency of carbonic acid occasioned by this, is about made up by the moisture which the carbonic acid gas carries off along with it. This renders the error, in general, trifling.

It will be proper to subjoin an example or two of the method of proceeding, to enable the reader to judge of the goodness of this test, and its value to the manufacturer.

The black oxide of manganese employed was subjected to analysis, and found composed of

Binoxide of manganese	-	-	-	68.49
Peroxide of iron	-	-	-	11.85
Water	-	-	-	5.68
Earthy matter	-	-	-	13.98

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100.00

*Experiment 1.*

Put into the flask—Water	-	-	-	599 grains.
Oxalic acid	-	-	-	75
Black oxide	-	-	-	50
Sulphuric acid	-	-	-	184

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Total - - - - - 908

Loss of weight 32.5 grains. It ought to have been 34.245 grains.  
Error 1.745 grains.

*Experiment 2.*

Put into the flask—Water	-	-	-	600 grains.
Oxalic acid	-	-	-	75
Black oxide	-	-	-	50
Sulphuric acid	-	-	-	154

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Total - - - - - 879

Loss of weight 34.5 grains. It ought to have been 34.245 grains.  
Here the error is in excess, and amounts 0.255 grains.

*Experiment 3.*

Put into the flask—Water	-	-	-	600 grains.
Oxalic acid	-	-	-	75
Black oxide	-	-	-	50
Sulphuric acid	-	-	-	154.1

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Total - - - - - 879.1

Loss of weight 35 grains. Here also the error was in excess, and amounted to 0.755 grains.

Let us take the mean of these three experiments:

Loss of weight by 1st	-	-	-	32.5 grains.
2nd	-	-	-	34.5
3rd	-	-	-	35.0

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3)102

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Mean - - - - - 34 grains.

Here the error amounts to 0.245 grains, which is considerably less than one per cent. If, therefore, three trials be made, the error will be under 1 per cent.; so that the method is quite sufficient to indicate very nearly the quantity of binoxide of manganese in any ore. Now, it is the binoxide of manganese alone that is useful to the manufacturer; the sesqui-oxide and red oxide availing very little in the preparation of chlorine, for which almost alone the ore is used by manufactures.

I tried various other proportions of the ingredients, but found the preceding the best. I tried, also, the effect of rubbing up in a mortar the oxalic acid and black oxide. But the error is least when the oxalic acid is merely poured into the water, and the black oxide added before the acid is dissolved. Unless the sulphuric acid be added last, we cannot be sure of our weights.

Rec. Gen. Sc. June, 1836.

*Evolution of Light during Crystalization.* A dull light sometimes appears while a solution is in the process of crystalizing, but the phenomenon has been considered as accidental and never exhibited at will, or as an experiment. A method has been pointed out by Henri Rose of Berlin, by which this light can be produced at any time.

Put two or three drams of arsenious acid, of a vitreous aspect, in a clear glass matrass, and sprinkle it with an ounce and a half of non fuming, common hydrochloric acid, and half an ounce of water. Heat it to ebullition, let it boil ten or fifteen minutes, then cool it as slowly as possible by gradually lowering the lamp or removing the heat. If the crystals begin to form in a dark place, the creation is accompanied with a vivid light, and the formation of each little crystal is attended with a spark. If the vessel be shaken a great number of crystals are suddenly formed, and as many sparks produced. If a larger proportionate quantity of the materials be taken, such as an ounce or two of arsenious acid, the light, at a favourable moment, will, on shaking the bottle, illuminate a dark chamber. This power of giving light sometimes continues two or three days in succession, but becomes very faint, depending evidently, on the continuance of crystalization, and not on the electricity of friction by agitation.

If the hot solution be suddenly cooled so as to produce a pulverulent mass of the arsenious acid, no light, or at best, a very feeble one, will be seen. The crystalization of sulphate of potash has been most frequently observed to emit light, but always accidentally, and never perhaps in the pure sulphate.

Arsenious acid is known to exist in two different isomeric conditions. It is either transparent and vitreous, or porcelainous and opaque. After fusion it is quite transparent, but in time becomes milk white and opaque, without any increase of weight. Both the specific gravity, however, and the solubility in water are different in these two states. In the opaque acid, commonly used as rats bane, no light has been observed by the author, or at best, a very feeble one, on slow cooling.

The cause of the evolution of light in the case now described, is considered by Rose as unknown, and in need of additional facts to render it intelligible. Berzelius remarked the appearance of light during the crystallization of fluoride of sodium, in a liquid which held that salt in solution.

*Jour. de Pharmacie. Avr.*

*Decomposition of Sulphates by Oxalic Acid.* M. Vogel of Munich, has ascertained that oxalic acid will decompose the sulphates of iron and copper so far as to set free the whole of the sulphuric acid, thus proving that it has a stronger affinity for the oxides of iron and copper, than sulphuric acid has. Its decomposition of gypsum, attributed to its affinity for lime, is well known. It is probable also that oxalic acid effects the complete decomposition of the sulphates, whose bases are the oxides of zinc, manganese, cadmium, &c. The oxalate of the oxide and oxidule of iron is a yellow powder, almost insoluble in water, and which heated to redness in a closed vessel, leaves the protoxide and carburet of iron. The oxalate of copper is a clear blue powder, insoluble in water. Heated to redness it yields metallic copper mixed with the protoxide. *Idem.*

*Spirit of Wood.* DAMAS and PELIGOT, have lately discovered a very remarkable product which they have named *Spirit of Wood*. It resembles very closely alcohol or spirit of wine. Treated with four times its weight of sulphuric acid it furnishes an ether which has precisely the same composition and density; and with various acids, benzoic, acetic, oxalic, &c. it yields as many different ethers, for which these gentlemen give exact formulæ. Its chemical agencies and properties appear to be quite as certain and well defined as those of alcohol, and it is presumed that ethers may be obtained from it which alcohol does not yield. Spirit of wood, purified, is already on sale, at Lemire's, Rue de la Verrerie, No. 19, Paris.

*Recueil Indus. Avril.*

*Note on the Assay of Gilded Ware by the Wet Process.* By H. BOULIGNY, *Assayer at Evreux*. The art of assaying the precious metals or determining their proportions in alloys, so long stationary, has within a few years made immense progress. M. Gay Lussac, in reducing to form his method of assaying by the wet process, has, if we may so term it, established the limits of this art in relation to silver. This process is nevertheless not generally adopted, notwithstanding its precision and other advantages. The application of this method to the analysis of gilding begins also to spread. It is thus practised: Boil the alloy in a matrass with nitric acid, and precipitate the silver by the normal solution. The proportion of silver being known, dissolve the chloride of silver in ammonia, and the gold, which is insoluble in that alcali, is recovered in the usual way, and finally weighed.

This process, which is very exact when the alloy contains no tin, appears somewhat complicated to assayers who are not accustomed to chemical manipulations. That which I propose, is founded on the same principles and will appear perhaps of easier execution as it does not require the use of ammonia.

Take a quantity of the alloy containing about 1000 of fine silver, boil it ten minutes in a ground matrass with 30 grammes of nitric acid at 22°, decant with care into a ground flask of the capacity of about 250 grammes; boil the alloy again five minutes in 15 grammes of nitric acid, at 36°, and decant with equal care this solution into the flask: pour into the matrass 30 grammes of distilled water to remove all the nitrate and add it to the two former solutions. The flask which contains them is to be stopped and set aside. If any particles of nitrate of silver should adhere to the orifice

of the matrass they must be carefully removed and added to the solution in the flask.

Fill the matrass with distilled water, and reverse it in a crucible to collect the gold which must be dried and weighed. This weight is that of the gold contained in the alloy, which must be brought to unity by the rule of proportion. If, for example there were 1114.82 of alloy and 4 mill. of gold have been obtained, the weight of this metal in 1000 would be the fourth term in the proportion  $1114.82 : 4 :: 1000 : x$

$$x = \frac{1000 \times 4}{1114.82} = 3.588$$

The flask containing the solution of silver and copper, will be marked as an assay for silver, and the operation will be completed.

If the alloy contain tin, which would be known by the presence of a white powder at the bottom of the matrass, this process would by no means answer. Recourse must then be had to cupellation and parting.

In terminating this note, I ought to observe, that this process is applicable only to gilding, which contains as a minimum of gold 150 to 1000 of alloy.

Annales de Chim. Nov.

*Patent Rotary Printing-Apparatus.* A patent has recently been taken out by Mr. Rowland Hill for a Rotary Printing machine. The types are imposed\* upon cylinders, to which they are firmly attached, and of which, except the marginal spaces, they occupy the whole surface. The pressure is given by blanket-covered cylinders of the ordinary construction.

The most important advantages of this arrangement are stated to be, first, That as the revolving type cylinder is constantly receiving its ink in one part of its revolution, and constantly impressing the paper in another part, the action of the machine is unceasing; whereby a saving of time of about three parts out of four is obtained in comparison with the ordinary printing machines, when moving at the same velocity; because in those machines the backward motion of the form,\* and the laying on of the ink, suspend for the time the process of printing. Further, as the motion of the type in this machine is continuous instead of reciprocating, the speed has been increased without difficulty or danger; and by this additional velocity, combined with the saving of time just described, the rate of printing is brought to about ten times that of the ordinary perfecting machines, i. e. those which print the sheet on both sides before it leaves the machine. Secondly, the reciprocating motion of the heavy form, inking table, and inking rollers of the ordinary machine entails such a loss of power and time, in comparison of the rotary motion which is here substituted for it, that it is believed, from careful observation, that, notwithstanding the great increase in speed, any given quantity of work will be executed at the expense of about one-eighth of the power required in the ordinary machine.

The facilities provided for fixing the type, detaching parts for correction, applying the ink and regulating its supply, are said to be fully equal, if not superior, to those of other machines.

Compared with the rapid machines used for printing the daily newspapers, the rotary machine will print two sheets on *both* sides with accurate register, while they print *one* sheet on one side with defective register.

Lond. Mech. Mag.

*Improvements in Steam Carriages on Common Roads.* We noticed in the preceding volume of this Magazine, two inventions of M. Galy-Caza-

\* These words are used technically.

lat, which were designed for the improvement of steam carriages. We have since learnt, by a communication from the inventor, that they are part only of a series which has for its object the accomplishment of a problem in which so many have failed, and so much capital has been unproductively expended—the construction of a safe steam carriage, for the conveyance of passengers at a desirable velocity on common roads, which shall be perfectly safe from accidents by explosion, &c.

After a long and careful examination of the subject, and many experiments, on a full scale, M. Galy-Cazalat decided, that the following ameliorations were all desirable in the most improved carriages yet known, and most of them necessary; these he conceives he has perfectly accomplished in his steam carriage,

1. An arrangement by which the liability of the axle-tree-crank to break is diminished.

2. A mode of suspension of the engine, &c., which prevents its action from being disturbed by joltage.\*

3. An apparatus for guiding the carriage, by means of the steam itself, with great facility.

4. An hydraulic break for diminishing the velocity, and, when desirable, entirely stopping a steam carriage, upon a declivity.

5. A steam-generator, of simple construction and little weight; with a fire place in which coal may be used as a fuel without giving out smoke.

6. An apparatus of great simplicity and of easy application, by which explosions of steam generators and boilers may be, at all times, *prevented*.†

7. An apparatus, also of great simplicity, and incapable of derangement, by which the water surface in steam generators and boilers is constantly maintained during the working of the engine at the same level.‡

It will be evident to all who understand the subject, that supposing M. Galy-Cazalat has succeeded to the extent which he describes, he has removed nearly all the more important impediments which have up to this moment obstructed the progress of this valuable application of steam power.

Mag. Pop. Sc.

## Progress of Civil Engineering.

### *Health of Cities.—Improvement of London.*

The immense importance of an ample supply of good water and the free circulation of pure air, to the inhabitants of cities and towns, is now universally acknowledged. During the prevalence of an epidemic, it is almost the dictate of *instinctive* wisdom to flee from the infected region, and seek for safety in places where the air and the water are uncontaminated. The preservation of the public health is the absolute duty of those who have the control of public affairs; and nothing within the range of this duty is of more vital consequence than to guard the purity of those elements that feed the flame of life in every human bosom, and regulate the functions which render the food we eat either nutritious or injurious.

\* Examined and approved by the Institute of France, and rewarded with their gold medal, in 1833.

† Examined, tested, and approved by *La Société d'Encouragement* of Paris, and rewarded with their large gold medal, in December, 1835. Described in p. 395 of the preceding volume of this Magazine.

‡ Described p. 397, as above.

To the improvements that have resulted from the progress of knowledge in the modes of eating, drinking, breathing and clothing, may be ascribed that remarkably increased longevity which is evident in many of those cities and countries where civilization and science are in the highest stages of advancement. Our American cities are increasing with a rapidity almost unknown, and, there is much reason to fear, without a due regard to the safety, health and comfort of their future inhabitants. That our climate is not, in general, so favourable to sound, robust health, as that of Europe, no one who has carefully observed the appearance and manners of the great mass of the population in both quarters will be disposed to deny. And yet, whoever compares the maps of the thickly settled, and regulated portions of our principal towns with those of European cities, will be struck with the far greater *paucity of open space* presented by the former.

The modern parts of London have been laid out with a most judicious regard to *good breathing*; but the supply of that great metropolis with good water, is still a desideratum which occasions much anxiety to all who are led by science and humanity to engage in schemes of improvement.

The river is still the chief source of supply, and whoever reflects upon the amount of feculent matter which must pass into that stream from a million and a half of inhabitants, will be prepared to admit the difficulty in devising any mode of effectual depuration.

"If the Thames water, (according to Dr. Bostock, who communicated the result of his interesting inquiry to the Royal Society in 1829), be suffered to remain at rest, completely undisturbed, for a period of many weeks, fermentation will take place, in consequence of the presence of the softer portions of human ordures; the liquid will become clear, with the exception of a small portion of insoluble sediment; it will lose all unpleasant smell, taste, and colour; and present, instead of animal impurities in solution, an increase of its ordinary saline contents. This increase is to the extent of between two and three times, with regard to chalk, or carbonate of lime; of between five and six times, with regard to gypsum, or sulphate of lime; and of twelve times the usual quantity, with regard to common salt, or muriate of soda. By this change in the relative proportions of its saline contents, the water ceases to be soft, and becomes hard, inasmuch as each pint of it is found to contain four grains and  $\frac{36}{100}$  of saline matter. Supposing, therefore, that the companies were to establish reservoirs of such magnitude as to allow the water to be lodged undisturbed therein, during a period of time sufficiently long for the depurative process by spontaneous fermentation to take place, which is to destroy all animal impurities in it, they would still supply the public with what, although clear and inodorous, would contain enough of chalk and plaster of paris to multiply, and render more severe, the various and innumerable degrees of derangements of the stomach and bowels, which so generally prevail in, and are almost peculiar to, this metropolis."\*

No process of filtration, whatever may be the materials employed in clarifying, can deprive water of the ingredients that are chemically dissolved in it. "Would any one, knowingly, and with cheerfulness, drink a tumbler of water from a river spring, which should have previously run through a succession of cess-pools, and afterwards been filtered through sand and gravel, because it may then appear clear and transparent? Yet such is the case with

\* Architec. Mag., Aug. 1836.

those, collectively, who drink, in some way or other, the Thames water of the London district!"\*

The report of a committee "appointed at a general meeting held at the Right Hon. the Earl of Euston's, M. P., in Grosvenor Place, on the 3d of March, 1836, for the purpose of taking into consideration Mr. Martin's plan for rescuing the Thames river from every species of pollution; for the improvement of the wharfage, the establishment of two great public walks, and for other objects of public utility and importance," has the following suggestions.

"What, then, are the conclusions to be derived from the various parts of the present statement in reference to the supply of water in London? They are as follows:—

"*First*, That the water of the Thames, in front of London, is *always* in a most intense state of pollution.

"*Secondly*, That the process hitherto adopted for purifying it (subsidence) has proved insufficient, and leaves the most objectionable impurities still behind in the water.

"*Thirdly*, That even a more effectual process (fermentation, supposing it to be adopted, notwithstanding the great waste of time and money which it would entail) would only substitute one evil for another, as far as the health of the consumers is concerned.

"*Fourthly*, That the most perfect, even, of all the processes of purification (filtration,) were it practicable, would not free such polluted water as that which we derive from the river (where it passes through London) from all its disgusting and injurious properties.

"And that, therefore, the only real remedy is to adopt the plan which turns away from the river the numerous streams of impurities that flow into it at present. And that the evil to be thus remedied is one fully, experimentally, and mathematically demonstrated; one which is of most serious injury to the health of a million and a half of the King's subjects; one, in fine, to which the public authorities cannot much longer refuse their most earnest attention."†

"It was given (says the Report) to the genius of Mr. J. Martin to devise the simplest, as well as the most completely effectual, plan for affording, at once, all that the public require, without injury to the rights and interests of the water companies, or interference with them; but, on the contrary, with manifest benefit to them, by saving any further outlay of capital, which they might think themselves called upon to employ in fruitless endeavours to satisfy public opinion. This plan may be defined in a single sentence; it consists in diverting, altogether, from the river every possible source of pollution within the London district; so that the water supplied from it to the inhabitants by the existing water companies shall become as unobjectionable as a noble river in its natural state ever offered to man; for, according to Dr. Bostock's evidence, given before the royal commissioners in 1828, The water of the Thames, when free from extraneous substances, is in a state of considerable purity, containing only a moderate quantity of saline contents, and those of a kind which cannot be supposed to render it unfit for domestic purposes, or to be injurious to health."

"*The manner in which Mr. Martin proposes to accomplish this object is by the construction of a close Sewer, 20 feet wide, and of adequate depth,*

\* Arch. Mag. Aug. 1836.

† Ib.

*along both banks of the river*, commencing on the north near Milbank, and proceeding towards the Tower, round which it will pass, if required, to terminate near the Regent's Canal; while that on the south, beginning at Vauxhall, and proceeding in the direction of Rotherhithe, is intended to diverge thence, and terminate near the Surrey Canal. In order to dispose of the polluting drainage thus diverted from the river stream, and confined within these two sewers running parallel to the river, and with somewhat more than the declivity of its bed, Mr. Martin places two great receptacles at their respective terminations, so arranged and constructed, that the accumulation of all the drainage of the metropolis shall not be productive of the smallest annoyance or insalubrity to the nearest inhabitants. With this view, a system of ventilation will be established, both for the great sewers and the receptacles, which will prove equally simple and effectual, whether the committee adopt the one proposed by Mr. Martin himself, who has acquired much knowledge on this point, from having studied the ventilation of coal mines, or apply another, suggested by one of their members, equally competent for the task. In either case, however, the destruction of all noxious effluvia will be accomplished; a consummation which, coupled with the prevention (effected by the great parallel sewers) of the hitherto frequent inroads of the tide into the lower ends of the common sewers, and the consequent backing of the drainage in them, together with other measures for excluding all offensive smells through the street gullies, will render the London drainage more perfect, and the labours of the Commissioners of Sewers less difficult."

*"Erection of two lines of colonnaded Wharfs.*—Great and important as the first object unquestionably is, which Mr. Martin's plan is destined to accomplish, it is not the only benefit which the metropolis will derive from its being carried into effect. Although it seldom happens that, in adapting any very extensive remedy to a public grievance, or in undertaking a work of magnitude for the good of the people, local and individual interests are not in some degree injured or invaded, Mr. Martin's plan has the additional merit of being little exposed to such an objection. On the contrary, his plan, by the next object which it embraces, and which is, as it were, its natural consequence, is calculated to add to the value of most of the individual interests affected by the line of its operations. That object is the erection over the two sewers of a line of colonnaded wharfs, which will afford in front of the present wharfs additional room; increase the convenience of the merchant and the labourer; facilitate the operations of trade; give greater security to property landed from vessels and barges; improve the navigation of the river by the assistance of the subjacent sewers, which will constitute uniform embankments; and, lastly, add some portion of time to the number of hours during which the craft can deliver or take in their cargoes. The immense, and recent, advances which mechanical science has made in this country will enable the architect and engineer employed in the construction of these wharfs to take advantage of their uniform arrangement, and apply, through the engines required for the ventilation of the two great sewers and receptacles, either to the entire range of wharfs, or to any part of it where it may be required; the power obtained from atmospheric pressure acting on a vacuum, which has been so successfully applied, of late years, to cranes and other machines, and which, in this case, it is presumed, would be gladly adopted by the proprietors of storehouses, manufactories and breweries situated on the banks of the river, whereby another great advantage to those proprietors would be obtained from Mr. Martin's plan.

Respecting this useful application of mechanical science, the committee have the satisfaction of being able to refer to the opinion of one of their members, who is perfectly acquainted with the subject."

*"Formation of two extensive Quays, or Public Walks.*—But even this great metropolitan advantage, secured by Mr. Martin's plan, must yield the palm to another of a more popular and attractive nature, arising out of the accomplishment of a third object contemplated, also, by Mr. Martin. The committee, therefore, feel particular satisfaction in having further to report, that the same plan offers the most favourable opportunity of establishing, at a comparatively small expense, a magnificent promenade on each side of the river, unequalled in Europe, by the conversion of the roofs of the colonnaded wharfs, just described, into parapeted walks, to which the public will be admitted gratuitously on Sundays, and at the smallest rate of charge on every other day in the week. It is thus that the patriotic idea of Sir Frederick Trench will be realised, in respect to the erection of quays on the banks of the Thames, without the liability to the several objections which powerful individuals and public bodies made to the purely ornamental and architectural project of that gallant officer, who, with high-minded liberality, has declared Mr. Martin's plan to comprise more than his own, to be greatly superior in usefulness, to the public, and to deserve his utmost support. It is thus, also, that the wishes, so often expressed of late, by Parliamentary committees, of affording to the mass of the population, the luxury, salubrity, and recreation of great public walks, in the very heart of London, will be accomplished at once, and on a more extensive scale than has ever before been contemplated."

*"Magnificent Architectural Promenade.*—It would be superfluous, on the part of the committee, to undertake to prove, that the establishment of a grand and magnificent public walk on each bank of the river, and behind a most crowded line of habitations running east and west of the metropolis, must be of infinite service to the neighbouring inhabitants, by affording them an opportunity of taking exercise in a reserved public walk (well calculated, too, for women and children,) and of enjoying a free and open atmosphere during the days and hours not devoted to labour, besides the benefit of a more direct intercourse. To these advantages they are certainly strangers at present, owing to their remote position from the parks, and from every other general resort of pedestrians; and, although a select committee of the House of Commons did recommend, in 1833, an extension and improvement of the embankment along the river from Limehouse to Blackwall, at a considerable expense to the parishes within that district, so partial a measure could only be useful to those whose residence is contiguous to the walk, without being of service to the inhabitants of the more central parts of the metropolis along the north bank of the river, where it is most required. On this point the committee have obtained the opinion of one of their body, who is a medical man, and who, having practised for the space of twenty years as physician to three extensive public institutions in London, principally connected with the relief of the sick poor of the river districts, has had numerous opportunities of ascertaining the effect of the impure water of the river, of the confined air of the streets and alleys adjoining to it, and of the want of exercise, on the general mass of the inhabitants of those districts. The committee specially refer to that opinion, in addition to that of the witnesses examined before the Parliamentary committee of 1833, principally because, in a question so entirely belonging to the consideration of public health, the long experience of a medical witness is more likely to carry weight with

those who have the protection of that health in their keeping. The want of means to take proper walking exercise, after a long day of laborious exertion, impairs the vigour of the body, produces among the working classes a morose and melancholy disposition, and engenders a spirit of dissatisfaction, which domestic privations are too apt to increase. Such feelings, in their turn, hurry their victims on to the resorts of the drunkard and the abandoned; where, if they imbibe not the spirit of discontent, they most assuredly sap the very foundation of their own health, and that of their future offspring. The committee, fully coinciding, also, in the sentiments expressed in the report of the select parliamentary committee, just alluded to, on public walks, refer with particular pleasure to the part of that report where the peculiar natural advantages which the metropolis might possess in respect to public walks on the banks of the Thames, are especially recommended to the consideration of the House of Commons."

*"Protection of Property.*—There is one more public benefit, which the establishment of a great walk on each bank of the Thames is calculated to secure, and which, hitherto, has not only remained unaccomplished, but has even escaped notice, namely, the protection of property on the river by night. It is a well-known fact, that, taking advantage of the many hundred craft which are left at night without a watch, and of the darkness, which conceals evil deeds, youthful thieves, and others, commit considerable depredations on the river. The brilliant illumination by gas of the great walks, and, if necessary, of the wharfs too, may be expected to put a salutary check to such guilty practices, and diminish the serious losses consequent thereupon; while the facility which the same walks will afford to the Thames patrol, of overlooking every movement on the river, will complete this, not insignificant, advantage to the public."

*"Formation of Public Baths.*—Connected, also, with the establishment of the great quays in Mr. Martin's plan, it will be found that an opportunity is afforded for the formation of large public baths, contiguous to the river, and so arranged that they shall not in the least interfere with the purity of the river stream. Respecting the necessity and utility of public baths, as far as regards the health and cleanliness of the working classes in London, it is scarcely necessary to cite any authority. Upon that important subject, however, as well as on the general effect which the extensive improvements and total changes effected, in the state of the river and its banks, by Mr. Martin's plan, will have in greatly promoting the salubrity of the populous districts near the Thames, the committee refer, with confidence, to the experience of the same individual whose opinion on public walks they have received, and who derives that experience from repeated observations made in London, and in all the principal capitals of Europe, constituting a valuable corroboration of the testimony of well-qualified witnesses given before the select committee on that subject."

*"Preservation and Application of Manure.*—The drainage received into the great receptacles, before mentioned, will be converted into manure, according to the method and practice very extensively adopted in China, on the continent of Europe, and of late years, also, in some parts of Scotland. This will be conveyed by well-devised arrangements, and under the influence of scientific measures, to different parts of the country, in covered barges, or properly constructed land-carriages. The value of this species of manure is almost incalculable. The best authorities place it far above every other, as containing in much greater abundance the very elements of which vegetable substances are composed, and on which their existence and growth

depend. By saving, therefore, the vast quantity of it which has hitherto been wasted in the metropolis, a *fourth*, and most important, benefit, that of fertilising, and rendering the land considerably more productive, will be conferred on the public, through the identical plan, which alone can secure to us the luxury of drinking wholesome and unpolluted water."

"*Financial Statement*.—On the financial part of a plan so simple, yet so gigantic in its results, a plan, too, which seems encompassed by fewer difficulties requiring pecuniary sacrifices, than are generally met with in great public schemes, the committee do not think it necessary to dilate at length. They have, however," produced an estimate (signed, *R. Dixon, Fellow of the Institute of British Architects*) by which the expenses of construction are upwards of £1,000,000 sterling; and another of income and expenditure, by which, after paying a dividend of 8 per cent., there appears a surplus balance of £206,000."

"The principal source of income is the manure, for which it is calculated to produce £200,000."

The report is dated London, April 23, 1836.\*

"*Mode of ventilating the Receptacles and Sewers generally, and of destroying all noxious Effluvia from them.* (Proposed by N. Ogle, Esq.)—Anxiety will naturally be felt respecting the method by which the exhalations from so large a collection of animal and other impurities, amounting, at a moderate computation, to several millions of pounds, are to be rendered imperceptible to the senses, and innoxious to health. With a view of removing all such feelings, I submit the following explanation of this very essential part of Mr. Martin's plan:—

"Over the great receptacles fires will be placed, so arranged that no air shall reach them but that which has been drawn through all the ramifications of the sewers which intersect the ground beneath the streets. Thus a constant in-draft of atmospheric air will be drawn down into the great sewers, which will prevent the effluvia, now too commonly perceptible during particular states of the weather, from rising into the houses or roads. As the heat from these fires will be used to generate steam to work, by engines, the pumps which are to be employed for the double purpose of removing the manure from the receptacles, and of producing a vacuum in the hollow columns and architraves, by which atmospheric pressure may be used as a constant power at every warehouse, wharf, and manufactory; the establishment of such fires will afford three direct advantages. But, besides these, another important result will be obtained from them; for, by blowing the waste steam, which has passed the engines, into the lofty chimney placed over the receptacles, another vacuum will be created, which will draw up through the fires, with vast rapidity, the air commingled with the sulphuretted, and carburetted hydrogen, the carbonic acid gases, and whatever else may be evolved from the fermenting mass. In order to keep those gases always in motion, the atmospheric air extracted from the hollow columns and architraves, as before stated, will be ejected with force into the great receptacles, thence to be drawn through the fires by the action of the above chimney. By this process all effluvia will be destroyed."†

"*The Institute of British Architects' Letter to John Martin, Esq., dated 43 King Street, Covent Garden, 3d March, 1836.*—My dear Sir,—As you were yourself present at the last ordinary meeting of the Institute, held on Monday, the 29th of February, you are fully aware

\* Arch. Mag. Aug. 1836.

† Ibid.

of the intense interest with which the members received the description of your admirable project for improving the discharge of the sewage of this metropolis, and relieving the Thames from those impurities which now so materially injure its waters, and affect the health of the inhabitants. I am, however, directed by a special resolution passed on that occasion, to present to you the thanks of the Institute for having submitted this important subject to their notice. Perhaps this acknowledgment may not be considered by you the less valuable, as proceeding from a body of professional men, whose practical experience enables them, even from so brief a view of the subject, to appreciate, in a general way, the important results which might arise from the adoption of a plan of such a nature. I am, my dear Sir, with every expression of sincere regard, yours very faithfully and truly,—*Thomas L. Donaldson, Honorary Secretary and Corresponding Member of the Institute of France.*”\*

In a future number we may present the objections to the plan of Mr. Martin, which appear in the *Architectural Magazine* of London, with other suggestions for the improvement of the metropolis.

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### Mechanics' Register.

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*Coins and Medals.* In a lecture lately delivered before the Society of Arts, Mr. Wyon described our present mode of engraving and multiplying the dies.

The selection of the best cast-steel for the purpose, he observed, was very important, and not sufficiently understood at present. The very fine steel that forms excellent gravers, and other cutting instruments, is unfit for the purpose, for unless hardened with great care, it is very liable to crack. The very coarse steel is also objectionable, as it acquires fissures under the die press. The object therefore is, to select steel of a medium quality—but the best steel may be spoiled, by want of skill in the smith who forges the dies.

When the rough die is brought to a table in the turning lathe, after being softened, the engraver commences his labours, by working out the device with the small tools in *intaglio* (sunk in), and when he has completed his work, the die is ready for hardening, which is, in itself, a very simple process—but one that is often attended with serious disappointment to the engraver, for it not unfrequently happens, that the labour of many months is either injured or utterly destroyed, from the steel itself being faulty or heated to excess. But supposing the original die, or as it is technically called, a *matrix*, to be uninjured by the process of hardening, it is reserved for the purpose of furnishing a *puncheon* (or a steel impression in relief.) For this purpose, a block of soft steel is turned flat at the bottom and obtusely conical at the top. In this state, its conical surface is compressed into the matrix by a blow from the multiplying die press: this gives us only the commencement of an impression, for the die becomes so hard by compression, as to require frequent annealing and re-striking before it is perfected. An impression taken in this way is called a *puncheon*, which, when the engraver has given it all the delicacy of finish existing in the original, is then hardened, and serves for the purpose of making dies for coining, by a similar process, viz., impressing the hardened steel into that which is soft.

The distinction, said Mr. Wyon, between striking medals and coins, is very essential, so much so, that I cannot avoid saying a few words on the subject. A medal is usually engraved in high relief, like those upon ancient coins, and it requires a succession of blows, sometimes forty or fifty, with repeated annealings, to make a perfect impression. A modern coin, on the contrary, is usually brought up with one blow, although with the disadvantage of the metal being harder. Standard gold, for instance, consists of one-twelfth of alloy: medals are usually made of fine gold; the engraving upon the coin is consequently made with a suitable degree of relief.

In striking a coin or a medal, the lateral spread of the metal, which would otherwise ooze out, as it were, from between the dies, is prevented by the application of a steel collar, accurately turned to the dimensions of the dies. The number of pieces which may be struck by one pair of dies, not unfrequently amounts to between three and four hundred thousand, but the average amount is much less. Mr. Wyon stated, that he remembered instances of twenty dies being destroyed in one day, owing to the different qualities of steel, and to the casualties to which dies are liable. There are, it appears, eight presses in the coining-room of the Mint, and he considers that the destruction of one pair of dies for each press per day, is a very fair proportion, though it is generally rather more.

It must be remembered, that each press produces sixty pieces per minute, without reckoning stoppages occasioned by changing of dies and other contingencies; and Mr. Wyon remarked, that in 1817, the daily produce of coins, in half-crowns, shillings, and sixpences, amounted to the enormous quantity of 343,000 per day, for three months: at that time all the eight presses were employed; but, on the 1st of last April, there were 125,000 pieces coined with five presses only. From the 4th of June, 1817, to the 31st of December, 1833, there were coined in sovereigns and half-sovereigns, 52,187,265*l.* sterling. *Arcana of Science, 1835.*

*Great Blast at Craighleith Quarry.* The long time in which preparations for a great explosion at this quarry had been going on, and the effects that were expected to result from the experiment, by a great saving of labour and expense, in at once dislodging a great mass of rock, and also lessening, if not altogether removing, the risk which attends the blowing up of small portions of rock from the flying fragments, rendered the experiment which took place on Saturday the 18th of October, 1834, a subject of much interest both in a public and scientific point of view. It having been intimated by bills that the blast was to take place at three o'clock, long before that hour crowds of people were proceeding along the roads leading to the quarry, and by three o'clock every place which commanded a view of the spot was filled with spectators. At the time when the explosion took place, there were no fewer than ten thousand persons on the grounds around the quarry; and curiosity was so much excited, that even the Castle-hill, and also on the Carstorphine-hill, a great many people were collected. At half past two o'clock, the conductor, inclosed in a block-tin tube twenty-six feet long and half an inch in diameter, was introduced into the bore. The depth of the bore was sixty feet, and seven and a half inches in diameter at the top, and six at the bottom, and was charged with 500 lbs. of Sir Henry Bridge's double-strong blasting powder. At half past three the match was lighted, and in three minutes the explosion took place. The report was not so loud as from a small piece of ordnance; but the effect

that was produced was highly satisfactory to all the scientific gentlemen present, and completely fulfilled the expectations that had been conceived by the projector. At the moment of the explosion, the great mass of rock appeared to those at a short distance to be forced upwards, and then to rend in large and deep fissures. It is calculated that upwards of 20,000 tons of solid rock have been displaced by this experiment. *Ibid.*

*To prevent Ink becoming Mouldy.* Add to each pint bottle of common writing-ink five drops of *kreosote*: it gives the ink a slight odour of smoked meat, which is by no means disagreeable, and effectively obviates its tendency to become musty. The same preventive applies with equal efficacy to Stephen's blue writing fluid.

*Kreosote* is a liquid extracted, by a circuitous process, from wood-tar, and may be purchased at the chemists' shops. *Lond. Mag. Pop. Sc.*

*Stereotype plates of Iron.* Mr. Zeigler, a printer of Blankenburg, in Brunswick, has printed a bible from iron stereotype-plates. The advantages of using this material for such a purpose are not stated. *Ibid.*

*Ploughing by Steam.* Some experiments have been tried at Red Moss, near Bolton, Lancashire, in the presence of Mr. Handley, M. P. for Lincolnshire, Mr. Chapman, M. P. for Westmeath, Mr. Smith, of Deanston, and other gentlemen interested in agriculture, with a new and very powerful steam plough, constructed by Mr. Heathcote, M. P. for Tiverton. About six acres of raw moss was turned up in the most extraordinary style; sods eighteen inches in breadth and nine inches in thickness being cut from the furrow, and completely reversed in position, the upper surface being placed exactly where the lower surface had been before. The possibility of ploughing by steam has thus been established, though the machine appears much too complex and costly for common purposes. *Mining Journal.*

*Results of Machinery.* Rapid as the increase of buildings in and about London has been, it is quite outdone by similar operations in Manchester, which is said to contain 700 streets more than it did four years ago. *Ibid.*

*Ingenious piece of Mechanism.* A very ingenious piece of mechanism, a miniature steam engine, has been constructed by Mr. Richard Corfield, a young man in the employment of Messrs. Gittins and Cartwright, at the Eagle Foundry, Shrewsbury. It consists of an engine not exceeding an half-inch cylinder, for the purpose of propelling a small steamboat, working its propelling shaft at the enormous speed of five hundred and fifty revolutions per minute—travelling a distance of thirty miles in one hour. The boiler is so constructed as to admit a spirit-lamp in the centre of the water, which affords sufficient fuel and steam for one hour. We should add, that the above is one of many extraordinary specimens of useful, though miniature and elaborate, works of art, made by Mr. Corfield. *Ibid.*

*To hasten the flowering of bulbous Plants.* Fill a flower pot about half full of quick lime, and over this put good mould, and in it plant the bulbs. Keep the earth always slightly moist, and press it down as it rises by the swelling of the lime. The flowers may thus be obtained in a very short time and at all seasons. *Jour. Conn. Usuelles, Mars.*

*To deprive Icelandic moss of its bitterness.* Steep it twenty-four hours in

an alkaline solution, then leave it a few hours in fresh water and the bitterness will be removed. Lye from wood ashes is very suitable. Ibid.

*Improvement of Coffee.* Many things have been proposed as substitutes for Coffee. Rye, and other grain, beans, peas, chicory, beets dried, &c. have in turn been proposed and their qualities valued. For some years past there has been sold in Paris, under the pompous name of *Coffee flowers imported from America*, a dark powder, a pinch of which really communicates to coffee a very agreeable aroma and allows of a little diminution of the quantity. I have examined this powder, and find it to be only sugar caromelized, or rather, almost completely charred. A small quantity of caromel produces precisely the same effect.

Chesnuts deprived of the envelope, cut into fragments of the size of coffee grains, dried and mixed with real coffee, roasted and ground together, are the best substitutes I have found. I have used it for thirty years. Some mix them in equal proportions. Bodin De La Pichonnerie. Ibid.

*Preservation of Aliments.* At a meeting of the Society for the Encouragement of National Industry in France, held March 16, 1836, Count de Lasteyrie announced the presence of Captain Ross, the celebrated navigator, and M. Jomard presented from him a tin box, containing preserved meat which he had brought from Cape Ferry, Lat. 72° 47' N. and 90° Long. west of Greenwich, where it had been deposited by Capt. Parry, in August, 1824. The box was prepared by Gamble and Donkin, London, about 1820. This box, after passing through the West Indies, had been exposed to the Arctic regions eight years, being brought back in 1832.

Bull. d'Encour. Mars. 1836.

### *List of American Patents which issued in July, 1836.*

*July.*

513. <i>Plough.</i> —Timothy Miller, Pittsburgh, Penn.	2
514. <i>Fractured thigh apparatus.</i> —Samuel Woolston, Vincentown, N. J.	2
515. <i>Plough.</i> —Isaac Snider, Mount Pleasant, Penn.	2
516. <i>Hydrant.</i> —Sater T. Walker, Baltimore, Md.	2
517. <i>Clover machine.</i> —William Loomis, Ashford, Conn.	2
518. <i>Ice breaker.</i> —Michael Freytag, Philadelphia,	2
519. <i>Anchor, cast-iron.</i> —James S. Stoddard, Palmyra, N. Y.	2
520. <i>Cooking stove.</i> —Chester Granger, Pottsford, Vermont,	2
521. <i>Rotary steam engine.</i> —Franklin Carpenter, Casenova, N. Y.	2
522. <i>Staves for barrels.</i> —Cyrus McGregory, Newport, N. H.	2
523. <i>Brick moulding machine.</i> —James Coppuck, Louisville, Ky.	1
524. <i>Raising water by weights.</i> —David Hess, Shepherdstown, Va.	1
525. <i>Sheaves for blocks.</i> —Cyrus Alger, Boston, Mass.	1
526. <i>Cooking stoves.</i> —Asael Lear, Wendell, N. H.	1
527. <i>Washing machine.</i> —William Newton, Warren county, Ohio,	1
528. <i>Generating steam, &amp;c.</i> —Isaiah Jennings, N. Y.	1
529. <i>Combs of metal.</i> —R. A. Ives, Bristol, Conn.	1
530. <i>Cleaning rags.</i> —George Carriel, Manchester, Conn.	1
531. <i>Clocks.</i> —Joseph Ives, Bristol, Conn.	1
532. <i>Hydrant.</i> —Sater T. Walker, Baltimore, Md.	1
533. <i>Sowing grain.</i> —William C. Greenleaf, Andover, Maine,	1
534. <i>Water wheels.</i> —Charles Kenzie, Troy, N. Y.	1
535. <i>Road making.</i> —John S. Williams, Fulton, Ohio.	1
536. <i>Churn.</i> —Davis Variel, Minot, Maine.	1
537. <i>Mill stone dresser.</i> —John Tusk, Columbus, Penn.	1
538. <i>Cutting straw.</i> —Mallory M. Marshall, Smithfield, Va.	1

July.

539. <i>Traveling trunks.</i> —Washington Sweetzer, Portsmouth, N. H.	1
540. <i>Spirits of turpentine, extracting.</i> —Isaiah Jennings, N. Y.	1
541. <i>Saddle.</i> —Otho W. S. Callahan, Staunton, Va.	1
542. <i>Shingle machine.</i> —Tunis T. Burhyte, Barton, N. Y.	1
543. <i>Woolen Yarn.</i> —William B. Walker, Hillsborough Bridge, N. H.	1
544. <i>Trunks, valises, &amp;c.</i> —William Brown, Brooklyn, N. Y.	1
545. <i>Rotary saw.</i> —Robt. S. Thomas, Rockingham, N. C.	1
546. <i>Frieze window, &amp;c.</i> —William Wooley, N. Y.	1
547. <i>Locks for doors, &amp;c.</i> —Almon Roff, N. Y.	1
548. <i>Mill for grain, &amp;c.</i> —Oliver Wyman, Watertown, Mass.	1
549. <i>Andiron bars.</i> —James Cochran, Batavia, N. Y.	1
550. <i>Tailoring, art of.</i> —James Wesler, Jr. Hagerstown, Md.	1
551. <i>Mattresses, bolsters, &amp;c.</i> —A. Salisbury, and J. Uram, Troy, N. Y.	1
552. <i>Cooking stoves.</i> —E. Andrews and S. Austin, Bradford, N. H.	1
553. <i>Distilling.</i> —A. R. Ken and H. Hoover, Waynesborough, Penn.	1
554. <i>Saws, straining.</i> —E. Rathburn and W. Tinker, Conneaut, Ohio,	1
555. <i>Force pump, double.</i> —John G. White, Dryden, N. Y.	1
556. <i>Truss for hernia.</i> —Isaac Thompson, Brattleborough, Vt.	1
557. <i>Cooking stove.</i> —Elish N. Pratt, Albany, N. Y.	1
558. <i>Mowing machine.</i> —William Greenleaf, Andover, Maine,	1
559. <i>Spark extinguisher.</i> —Gabriel Winton, Donaldsonville, Louisiana,	1
560. <i>Plough.</i> —John M. Tilford, Murfreesborough, Tenn.	1
561. <i>Awl haft.</i> —William Campbell, Gilsum, N. H.	1
562. <i>Saddles, ladies'.</i> —William Jenkins, Ithaca, N. Y.	1
563. <i>Fire place.</i> —Reuben Buck, Acton, Maine,	1
564. <i>Chimneys, ovens, &amp;c.</i> —Elisha Smith, Ithaca, N. Y.	1
565. <i>Foot stove.</i> —Ezekiel Duball, Canaan, Conn.	1
566. <i>Gun and pistol lock.</i> —Johnson Marsh, East Dorset, Vt.	1
567. <i>Water wheel.</i> —Samuel Garrett, Londonville, Ohio.	2
568. <i>Fires, extinguishing.</i> —Isaac Clowes, Norfolk, Va.	2
569. <i>Brick machine.</i> —Calvan Waterman, Bath, Maine.	2
570. <i>Locomotives and rail roads.</i> —Isaac W. Edgar, Wayne co. Ohio.	2
571. <i>Bolts and spikes, drawing.</i> —Richard Haynes, Portsmouth, Va.	2
572. <i>Gimblets, forging.</i> —De Grasse Fowler, Wallingford, Conn.	2
573. <i>Ventilating stoves.</i> —Clement Woodward, Washington, D. C.	2
574. <i>Saw mill.</i> —Samuel Goudy, Greensburg, Ken.	2
575. <i>Grates, pendulum.</i> —Nathan Winslow, Portland, Maine.	2
576. <i>Cooking stove.</i> —Philip C. Traver, West Troy, N. Y.	2
577. <i>Heating rooms and ovens.</i> —John A. Pitts, Winthrop, Maine.	2
578. <i>Feather dresser.</i> —T. P. Knowlton, Clermont, N. H.	2
579. <i>Stoves.</i> —Howell Porlahee, Watervliet, N. Y.	2
580. <i>Sewers of hydraulic cement.</i> —Obadiah Parker, N. Y.	2
581. <i>Platform balance.</i> —John Horton, Madrid, N. Y.	2
582. <i>Trashing machine.</i> —Aaron Parsons, Rockfield, Maine.	2
583. <i>Vessels, construction of.</i> —Daniel Gerrish, Boston, Mass.	2
584. <i>Lock for doors, &amp;c.</i> —James McClory, N. Y.	2
585. <i>Lever press.</i> —G. Guyon, N. Y.	2
586. <i>Cooking stove.</i> —Elisha Lyman, Easthampton, Mass.	2
587. <i>Horse power.</i> —Charles G. Gilbert, Leeds, Maine,	2
588. <i>Water wheel.</i> —William F. Brown, Augusta, Maine.	2
589. <i>Cotton gin.</i> —James McCreight, Winnsborough, S. C.	2
590. <i>Smut machine.</i> —Rufus Dennison, Wilton, Maine.	2
591. <i>Washing machine.</i> —James H. Littel, Skeneateles, N. Y.	2
592. <i>Ship thimbles.</i> —Prentiss White, Yarmouth, Mass.	2
593. <i>Fly net for horses.</i> —Henry Korn, Philadelphia.	2
594. <i>Wool and flax comber.</i> —William W. Calvert, Lowell, Mass.	2
595. <i>Hat bodies, stiffening.</i> —Edward P. Spear, Lexington, Mass.	2
596. <i>Smut machine.</i> —Jonas Pratt, Otsego, N. Y.	2
597. <i>Neck stocks, shaping.</i> —Thomas Goodman, N. Y.	2
598. <i>Marsh drainer.</i> —Jean Blanc, New Orleans, Louisiana.	2

## CELESTIAL PHENOMENA, FOR DECEMBER, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.				N. 12°	V.69°
24	16	57	Im	α Cancri	,6,		
24	17	40	Em			300	558

## Meteorological Observations for August, 1836.

Moon.	Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
☾	1	63°	86°	29.70	29.76	SW.	Moderate.	.8	Cloudy—shower.
	2	66	79	30.00	30.00	SW.	do.		Cloudy—flying clouds.
	3	64	74	30.00	29.95	SE.	Brisk.	.28	Cloudy—rain flying clouds.
	4	68	73	29.80	29.80	W.	Moderate.		Clear.
	5	64	77	30.05	30.10	NE.	do.		Lightly cloudy—clear.
	6	60	62	30.10	30.10	E.	Brisk.	1.00	Rain—Cloudy.
	7	63	70	30.09	29.95	SE.	Moderate.		Cloudy—lightly cloudy.
	8	64	80	30.00	29.95	W.	do.	.15	Cloudy—clear—shower.
	9	70	68	29.80	29.90	NE.	do.		Clear—floating clouds.
	10	55	70	29.95	29.95	SW.	do.		Lightly cloudy.
☾	11	60	67	29.90	29.86	SW.	do.	.10	Cloudy—rain.
	12	56	72	29.83	29.90	ES.	do.		Clear.
	13	60	80	29.90	29.90	E.	do.		Cloudy—clear.
	14	66	79	29.75	29.75	SW.	do.		Cloudy—clear.
	15	64	70	29.85	29.90	W.	do.	.11	Cloudy—clear.
	16	61	79	29.90	29.95	SW.	do.		Cloudy, do.
	17	63	73	29.95	29.95	W.	do.		Clear, do.
	18	68	76	29.96	29.90	S.	Brisk.	.36	Clear—lightly cloudy.
	19	68	82	29.70	29.70	W.	do.		Clear—flying clouds rain in night
	20	66	81	29.91	29.90	W.	do.		Partially cloudy—clear.
☾	21	52	73	29.96	29.95	SW.	Moderate.		Clear day.
	22	62	74	29.86	29.9	W.	do.		Clear day.
	23	56	65	30.00	30.04	N.W.	do.	.5	Cloudy—clear.
	24	59	70	30.00	30.03	N.NE.	do.		Lightly cloudy—do.—rain.
	25	62	70	30.10	30.10	NESE.	do.		Cloudy—partially cloudy.
	26	64	69	30.00	29.90	S.W.	do.	.17	Cloudy—flying clouds.
	27	64	76	29.80	29.80	S.	Calm.		Cloudy—rain.
	28	65	80	29.87	29.85	NE	do.		Cloudy—clear.
	29	66	74	29.90	29.85	NW.W.	do.		Clear day.
	30	62	69	29.70	29.70	SW.	Moderate.		Fog—cloudy—rain.
☾	31	51	72	29.90	29.90	NW.	Brisk.		Clear do.
	Mean	62.52	73.42	29.91	29.91	W.	do.	1.25	Clear do.

## Thermometer.

Maximum height during the month	86. on 1st.
Minimum	51. on 31st.
Mean	67.97.

## Barometer.

30.10 on 5th, 6th, 25th.
29.70 on 1st, 19th. & 30th.
29.91.

**JOURNAL**  
OF THE  
**FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**  
DEVOTED TO  
**Mechanical and Physical Science,**  
**CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,**  
AND THE RECORDING OF  
**AMERICAN AND OTHER PATENTED INVENTIONS.**

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DECEMBER, 1836.

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**Practical and Theoretical Mechanics and Chemistry.**

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*Report of the Committee of the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, on the Explosions of Steam Boilers. PART II., containing the GENERAL REPORT of the Committee.*

(CONTINUED FROM p. 306.)

71.—III. *Explosions may arise from defects in the construction of a boiler, or its appendages.*

This comprehensive division includes the discussion of the form, material and mode of manufacture of the boiler and of its appendages. The Committee have, however, no desire to interfere with the present or future state of the engine in these respects, further than as their duty requires them to give candidly to the public, their opinion of facts which are on record.

72. 1st.—*Form.* The influence of the form of a boiler in producing danger is of course very great; but to consider the numerous varieties of form would be impossible, even if their minute differences were known to the Committee. Every boiler should be required to stand frequent proofs as a test of its sufficient strength, but the working properties of each, with originally adequate strength, may be very different.

73. It may, in general, be remarked, that the old wagon-boiler of Watt, should be only used when very low steam is employed. The varieties of

the cylinder boiler, with or without interior flues, are in most common use in the steamboat-engines of this country. Of these, experience, both abroad and at home, has shown those without flues to be the more safe, and those with them the more economical. The heads of these boilers are, in this country, plane surfaces; in England, frequently, hemispherical, and in France, are required by law, to be of the latter named figure. There is no reason, however, to doubt the sufficiency of strength of the thick plane wrought-iron heads. Of the flues used, those in the smaller cylinders, which pass directly through both heads of the boiler are the more safe;\* the flues passing through the convex surface, called *L* flues, and those which in the larger boilers return without passing through both heads, add nothing to the strength of the cylinders. Observation has shown that boilers with interior furnaces, or flues, commonly give way by the yielding of the flues, or by blowing off the heads. The tubular boilers of Woolf, have, but in one case, as far as the knowledge of the Committee extends,† been used in this country. Other forms of tubular boilers, in which very small tubes contain the water to be vaporized, have, in no case, to their knowledge, on full trial been found successful. The case is very different when, as in the locomotive boilers, the tubes are used as flues: and for obvious reasons. Such boilers have, however, only lately been applied to steamboats.

There does not seem to the Committee, evidence to show that any of these forms are essentially dangerous, though, as before remarked, there are grades among them as to impunity from careless management. From this remark, however, in some degree, should be excepted the *L* flue-boiler, which is incident always to a source of danger, hereafter to be pointed out. The remarks apply to single, or detached boilers.

74. Connected boilers, on board of steamboats, are incident to a source of danger which has already been pointed out, (art. 59, &c.) and after examining the remedies which have been proposed to meet these circumstances, the Committee are of opinion that they are of so varied a kind that the use of these boilers cannot be continued without certain danger, and therefore ought to be laid aside. Those at present in use could easily be detached, so as to connect only two boilers at most, and have a separate supply-pump for each pair.

75. In a former division of the subject, (II.) the Committee showed the great danger which is produced in a boiler by highly heated metal; any boiler, therefore, which has parts exposed to heat, without being in contact with water, is essentially defective. The *L* flue boiler is of this kind, though as it is only used in small cylinders, the exposure is not considerable.‡ The boiler with a steam-chimney presents an extension of this exposure, the boiler being continued up vertically at one end, so as to inclose the flue.§

\* Experience seems to warrant this conclusion, and it does not appear probable that the difference of temperature between the flue and outer shell, even in boilers with interior furnaces, can be sufficient to injure a wrought-iron head, by the excess of the expansion of the flue. The case is different when cast-iron is used for a boiler-head.

† At Richmond, Virginia. See Burr on Explosions. Journ. Frank. Inst. vol. vi. p. 334.

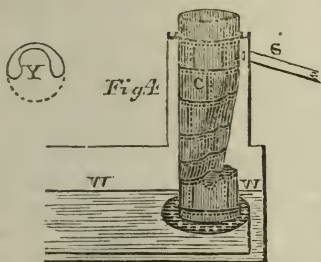
‡ A curious case of the overheating of a flue by the accumulation, and subsequent taking fire, of soot, is described by Mr. Hebert, in No. XI. of the Replies to the Circular of Committee on Explosions.

§ It should be recorded to the credit of the liberal minded patentee of this boiler, that he has afforded every opportunity to investigate its defects, and appears no sooner to have been convinced of the danger to particular parts of it, than he has applied his skill to produce a remedy.

The idea is to economise the heat found in this flue, by heating the steam which is around it, and thus producing a small surcharge of heat which prevents condensation in the steam-pipe and cylinder. But the flues which the chimneys inclose, are thus exposed to become unduly heated. Two explosions which have occurred in boilers with steam-chimneys\* have torn the same portion of the flue, and were so similar, as to show that they are to be attributed to an inherent defect in this construction. Indeed the presence of metal through which a highly heated draught is passing, while it is in contact only with steam, which cannot carry off the heat rapidly, is sufficient to warrant a decision against such a form of boiler, even if facts had not spoken so loudly in regard to it.

76. The Committee feel constrained to recommend to constructors to discontinue the making of connected boilers, of those with L flues, and with the extension constituting a steam chimney.

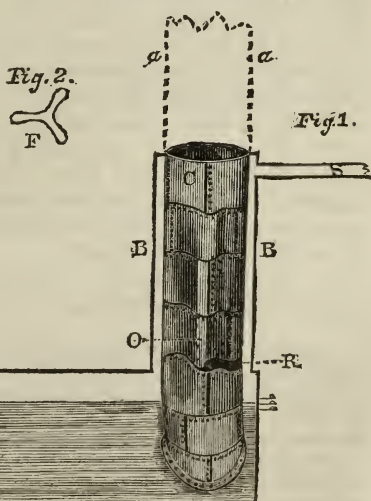
\* In justice to the force of this conclusion, the Committee feel it necessary to give extracts from the excellent accounts of the explosions on board of the Ohio and of the William Gibbons steamboats, by Thos. Ewbank, Esq., of New York. The first of these explosions occurred on the Hudson, in 1832, and the second in New York harbour in 1836. The annexed figures represent in plan and section the ruptured flue of the Ohio.



WW, in the elevation, is the water line, C the flue around which the steam chimney is placed, and S, the steam-pipe leading from the steam-chimney. The rent took place from fifteen to twenty inches above the water line. This part of the flue is always exposed to the heated air from the horizontal flues which unite in the flue E, and is never covered by water. The line of fracture does not deviate more than six inches from a horizontal line. It is partly along a line of rivets, but chiefly through the centre of the sheets. In portions of one sheet, the metal is reduced from its original

thickness of one-quarter of an inch, to one-eighth, and even to one-sixteenth of an inch. Jour. Frank. Inst.; vol. x. p. 226, No. XXIX. Replies to Circular, &c. The

William Gibbons has one boiler of wrought iron, and similar in construction to those of "The Ohio" and "New England," but having a greater number of horizontal flues. The flue BB, within the steam-chimney, was collapsed so as to form a three cusped figure, as shown in fig 2. The rent R, thus produced, was four inches above the roof of the boiler. It was in one of the horizontal seams, and confined almost wholly to it, extending nearly three feet, or about one-third of the circumference of the flue. The flue was iron, one-fourth of an inch in thickness, and its thickness was not sensibly diminished previous to rupture. Jour. Frank. Inst. vol. xvii. p. 298. The fuel used ordinarily, was a mixture of anthracite coal and wood, but, on this occasion, it appears that the fire had been urged with quantities of wood.



77. It would be improper to leave this part of our subject, without calling attention to another point in the construction of boilers, which is to be avoided. It is the formation of small spaces intended to contain water and surrounded by fire.\* All experience has shown that steam cannot be generated in small tubes without driving out the water, and these arrangements are equivalent to tubes; and besides being liable to the accumulation of deposits, they are exposed to have the water carried from them unless when under considerable pressure. The weakness of boilers of these irregular forms should never be lost sight of.

78. *2nd.—Material and manufacture.* As early as 1818 a Committee of the British House of Commons, on the authority of practical and scientific men whom they examined, recommended the disuse of cast-iron as a material for steam-boilers. This material has now so generally been abandoned, for this purpose, that remarks upon its defects are not necessary. Even the cast-iron heads for boilers which were used a few years since on the Mississippi are, the Committee believe, now giving place to wrought-iron ones. The materials in common use for steam boilers are wrought-iron and copper.

79. The Committee have made, by the arrangement stated in the preface to the first part of their report, an extensive series of experiments on the strength of the different varieties of wrought-iron and copper, manufactured for steam boilers in the United States. These experiments they hoped to have presented before making this report, but circumstances not now necessary to be made public, have prevented them from doing so, and they deem it inexpedient longer to delay on this account. They must refer, therefore, to a report, specially upon this subject, for a complete development of their views, as well as for information in regard to the proper thicknesses for steam-boilers, working under different pressures. They ought, however, to remark here, that the views usually entertained of the importance of working iron, have been entirely confirmed by them. The ultimate strength of a bar, or sheet of iron coinciding more nearly with the strength which the whole bar exerts to prevent a first fracture, or the bar or sheet being rendered more uniformly strong, and therefore better adapted for use in the construction of steam-boilers, the more it is worked. Iron which has been heated nearly to redness has its tenacity permanently injured, being affected, though in a less degree than copper, the weakness of which in such a case has long been well established.†

80. There can be no doubt that the strength of boilers may be diminished by constant and often unequal pressure, by which the material is injured so far as to give way under a less strain, than that which it may once have borne.‡ By ordinary wear, from oxidation, &c. their strength is necessarily much impaired.

81. When salt water, or spring water highly charged with saline matter, is used to feed boilers, iron is very rapidly acted on, and extreme care

\* Ewbank on the explosion of the boilers of the steamboat New England. Jour. Frank. Inst., vol. xiii. pp. 292, 293.

† On both these points see also the remarks of Mr. Lester in Replies to Circular, &c. No. XVII. where the fact is stated both in regard to iron and copper, as resulting from his own experience.

‡ See Replies to Circular, &c. Nos. II. and XII. Col. S. H. Long and T. Bakewell, Esq.; also evidence of Mr. Bramah before Com. of House of Commons, 1817, Dodd's collection.

should be used in frequently cleansing them.\* Careful owners would resort to more frequent proof by the forcing pump than in other cases. This would serve to detect corrosion in particular spots, to which the material is so liable. Copper boilers not being similarly acted on, are more safe in such situations, but there seems no reason to suppose that iron may not be safely used, with due precaution.

82. Instances of dangerous defects in construction, or arising from use, in boilers are but too well attested. The awful explosion on board the steamboat *Helen McGregor*,† by which more than thirty persons lost their lives, took effect by forcing off the cast-iron head of a wrought-iron boiler, throwing the boiler in the opposite direction: the head was known to be cracked, before the explosion occurred. It is not clearly made out whether this result was produced by a gradual increase of pressure,‡ or by the return to its level of the boat; which had been careened by stopping at a landing place. The steam was not let into the cylinder to propel the engine, when the explosion happened. The boiler was one of six connected boilers of three feet diameter. A cast-iron head should never be united to a wrought-iron boiler with flues,§ since, independently of the defects to which the metal is liable, the inequality of expansion is very likely to crack it.||

83. A defect in a wrought-iron boiler head, was detected, by one of our correspondents, which we are surprised that any boiler maker should have allowed to pass. In turning the flanches by which the head is riveted to the cylinder, the iron was turned so sharply, as to crack it more than half-way through. This was one of four boiler heads belonging to the same set, found by Mr. E. W. Benton to be unsound. They could not have stood proving.¶

There can be no doubt but that the repairs to the boiler of the *Caledonia* were improperly made,\*\* an iron plate having been fastened upon the boiler with copper rivets: this seems, at least in part, to have been the cause of the accident which subsequently occurred.

84. The idea seems formerly†† to have been entertained that dangerous explosions could not occur in wrought-iron boilers, which were merely rent without doing injury. It is almost needless to remark that the whole tenor of the evidence before the Committee contradicts the idea. Wrought-iron may even be separated into fragments, but the great source of danger is in the escape of the hot water, which, with the steam generated by it, produces death in one of its most painful forms.

85. Steam-boilers should not only be proved when originally made, but

\* An instructive description of the action of salt water on iron will be found in the evidence of Professor Faraday before the Com. H. Commons of Eng. on steam navigation, 1822.

† Nos. III., IV. and XXI. of Replies, &c.

‡ Replies to Circular, No. IV.

§ See also explosion of *Atlas*, Replies, &c. No. VIII., and No. XXI., *Car of Commerce*, No. XXI.

|| Evidence of John Taylor, Esq. before Com. of House of Commons. A cast-iron boiler head affixed in his shops to a wrought-iron boiler and originally proved with a pressure of 100 lbs. cracked by heat when only exposed to a pressure of steam of 20 lbs.

¶ No. VIII. Replies, &c. Boilers of *Tally-ho Steamboat*.

\*\* Replies, &c. Nos. V., VI., VII., VIII., XXI.

†† Evidence before Com. of House of Commons. *Dodd's Collection*.

from time to time, to guard against their gradual wear, or accidental injury; and especially after every important repair made to them. In the intervals care must be secured by other means. These proofs have been recommended by most of our valued correspondents.

86. In the attachment of sheets of metal to each other to form boilers, and in the fixing of heads to boilers, constructors appear to have lost sight of the fact that the metal which is taken out for the rivet holes weakens the sheet, and that materially. In examining cases of explosion from direct pressure, and where no undue heating or special weakness has led to the result, the lines of rivets appear to determine the direction of the first fracture.\* A very neat example of this was given in the bursting of an iron cylinder in the experiments of the Committee.† The head of the cylinder was forced off, carrying with it the metal which projected beyond the line of rivets. The rivet-holes had cut out rather more than half of the circumference of the metal forming the convex surface, along the circle passing through the centres of the rivet-holes, and thus had made the strength of the convex surface to resist rupture in a direction perpendicular to the axis of the cylinder, less than its strength to resist a rupture in the direction of the axis.‡

87. The exposure of joints, formed by the junction of boiler plates, to the fire, may be mentioned as liable to produce very rapid wear. The heat is not conducted off as rapidly as by the other parts of the boiler, and the lower sheet is exposed to rapid oxidation.

88. *3rd.—Appendages to the boiler.* Of these the principal ones have already been made the subject of remark, and recommendation by the Committee. The forcing pump, as one of the most important, deserves further notice in this place. It is not the intention to recommend any particular form of this pump, especially as the Committee believe that most commonly in use to be entirely adequate to all its objects. They may remark, however, that they consider several valves between the supply reservoir and the pump, and also between the pump and boiler, as of the greatest importance. They would further recommend to be placed on the eduction pipe a cock similar to that used in locomotive engines. A rod and handle connected with this should be placed in a convenient position, for the engine-man to ascertain, by turning the cock, if the pump is in action. Although this apparatus cannot dispense with due attention to the means of ascertaining the level of the water within a boiler, it may give notice of a defective supply, in time to apply a preventive, instead of a remedy.

89. The Committee consider that their remarks already made in relation to the mode of applying heat to a boiler have been sufficient. They do not see that the use of a fusible metal or fluid bath can be applicable, in practice, to the heating of a steam boiler, or would, if applicable, realize the advantages which have been claimed for them.

The recommendations embodied in the present division of the subject will be found carried out by the suggestion of appropriate enactments in the project of a law which is appended to this Report.

\* Ewbank on the Explosion of the Boilers of the New England Steamboat. Jour. Frank. Inst., vol. xiii. p. 293.

† Report of Committee on Explosions. Part 1, p. 67. Jour. Frank. Inst. vol. xvii. p. 224.

‡ With an equal thickness of metal the strength in the former case would have been double that in the latter.

90. IV. *Carelessness, or ignorance, of those intrusted with the management of the steam-engine.*

It might be supposed that the fact once known that the engineer or fireman, who, from carelessness, or other cause, allows a boiler under his charge to explode, is in almost every case the first victim of the disaster, would produce care in those intrusted with the engine. But experience shows that this is not so; and the Committee, in proposing remedies, do but the duty which has been confided to them, and proved indispensable by examples, not to be mistaken or disregarded.

91. Familiarity with any sort of danger is so sure to produce callousness to it, and due caution is so apt to be considered as timidity, that a tendency to carelessness must be considered as the natural consequence of the situation of an engineer, or fireman. The subject of the causes of explosions in steam-boilers has been so little investigated, that men well versed in general science might be excused for ignorance of it, and steam-engineers should not therefore be too harshly or hastily blamed for what is incident to the nature of the subject, rather than the fault of the profession. The fact of carelessness or ignorance has however been so much insisted upon by our correspondents\* that it must be assumed, and endeavours made to apply a remedy.

92. In the present state of general education in our country it would obviously be impracticable to insist that firemen, or even steam-engineers, should be versed in the scientific principles, which regulate the use of steam. The public have, however, a right to expect from employers, that their agents, who are intrusted with human life, should have a thorough practical acquaintance with the steam-engine, and to demand that those who have information of the sources of danger, should lay down plain rules for the guidance of those who have been referred to. As a guard against carelessness, the public have further a right to expect from the higher authorities, beginning with the chief engineers, and rising to the captains of steamboats and masters of ships, that they should exert all the moral influence which vigilance can produce. And from the law, that it should constrain all these, by appropriate penalties, to the discharge of their responsible duties.

This view the Committee have carried out in the project of a law which accompanies their report.

93. V. *Cases of collapse from a partial vacuum within a boiler, or its flues.*

These cases are so little applicable in the state of the steam engine in this country, that the Committee have postponed their discussion until the last.

It is certain that the boiler of a high pressure engine of proper strength for ordinary purposes, would also be able to sustain the action resulting from even the sudden formation of a vacuum within it. Low pressure boilers have been crushed by the pressure of the atmosphere when a vacuum has been formed within.† These accidents are effectually guarded against, as far as experience has shown, by a valve opening inwards with which Watt's boilers were provided.

94. A case of explosion at the Mold Mines, in Flintshire, which has

\* Replies to Circular, &c. Nos. III., VIII., IX., XVII., XIX., XX., XXI., XXIII., XXVIII. Also, Remarks by "an Engineer," Philos. Mag. vol. i. &c. &c.

† Arago on Explosions. Annuaire du Bureau des Long. 1830, pp. 148, 169 and 170, also Journ. Frank. Inst., vol. v. pp. 404 and 412.

been circumstantially detailed by John Taylor, Esq.,\* seems to prove that a rarefaction produced in the interior flues of a high pressure engine, may determine an explosion of the most violent description. The boiler which exploded, belonged to a set of three, feeding the same engine. The fuel used was bituminous coal. The furnace doors of all three of the boilers had been opened and the dampers of two had been closed, when a gust of flame was seen to issue from the mouth of the furnace of these latter, and was immediately followed by an explosion. The interior flue of this boiler was flattened from the sides, the flue and shell of the boiler remaining in their places, and the safety valve upon the latter not being injured. Mr. Taylor states it as probable, that the steam pressure at the time of this accident did not exceed thirty pounds, and that the water was at its proper height. He assigns as the probable cause which determined the collapse of the flue, the ignition of a mixture of gas from the coal with atmospheric air, the contents of the furnace not being carried up the chimney on account of the closing of the damper, by which a partial vacuum was produced. If the strength of the flue was but little more than sufficient to resist a steam pressure of thirty pounds, it is plain that the cause assigned is adequate to have produced the effect. It must be admitted, however, that the testimony of the fireman who escaped injury by the explosion, and who would have been subjected to all the blame of the accident, if any attached, his comrades having been killed, is of that kind which induces a doubt, whether the steam pressure and height of water, were exactly as stated.

The accident, however, suggests the precaution as necessary with coal, and with some kinds of wood, not to close a damper soon after fresh fuel has been added; if the furnace is within the boiler, the injurious effects may be very serious, even more so than in the cases already referred to, where the furnace is not so placed.

95. That a vacuum can occur within a steam-boiler which is in action, as has been propounded within a few years past, is a supposition too palpably contradicted by the facts of the case to require any examination here.

96. VI. Having closed the subject of the means of preventing explosions in steam boilers, the committee have yet to consider *whether it is possible to provide protection against their effects when they occur.*

The very respectable scientific and practical men who have at different times drawn the attention of the public to this matter, give undoubted authority to the suggestion. The means proposed are, by carrying the passengers in a separate boat from the engine, or by placing the boilers on the guards of the boat, and separating them from the parts occupied by the passengers, by a suitable bulwark.

97. In regard to the first of these plans, it has been attempted, and for want of sufficient patronage by the public, has been laid aside. Public opinion seems to set strongly towards precautions which shall render the engine safe, without crippling its power of giving speed.

98. The larger steamboats on our Atlantic waters have generally the boilers upon the guards,† but without any obstruction between them and

\* On the accidents incident to steam boilers. Philos. Mag. vol. I. see also remarks upon the same by "a practical engineer," and by W. J. Henwood, in the same volume.

† We are pleased to see that a boat in which the boilers are placed upon the guards has been put in operation upon the Mississippi. This we trust is only the first of many of this kind to be hereafter constructed.

the inner parts of the boat. This affords but a partial security, diminishing probably the extent, but not preventing, the destruction of human life. That a bulwark of sufficient strength to protect against explosion, without adding too much to the weight of the boat, can be devised, the Committee are not prepared to assert positively, though they believe that it could.

99. Their views incline entirely to the protection of the hands, as well as passengers by rendering the boiler safe, and they fully believe that this may be done without incumbering the boats now in use, or requiring, in a majority of cases, an entire change of structure in the engine.

They have, however, to meet opinions which they hold in so much respect, introduced a clause in the proposed bill, annexed to this report, by which a bounty is, in fact, offered upon a boat constructed with suitable bulwarks between the interior part and the boiler.

100. The Committee having now completed their examination of the causes of explosion, with their preventives, as far as they are informed upon the subject, and made all the recommendations, which this examination has suggested to them, refer to the accompanying project of a law for the regulations of the boilers and engines of steam-vessels, for the means of carrying the more important of these suggestions into effect.

The provisions of this law refer only to the means of preventing the explosions of boilers of steamboats, or of affording protection against their effects. With the regulations in regard to the navigation or police of the boats, however important, this Committee do not feel warranted in interfering. They believe that the experience necessary to frame such regulations will be found in the appropriate Committees of Congress, upon whose attention they would respectfully urge the annexed provisions relating to the engine.

That such an enactment will contribute to the safety of the public, without interfering injuriously with those interested in the navigation by steam or in the manufacture of the steam-engine, is the deliberate opinion of this Committee.

Respectfully submitted,

In behalf and by direction of the Committee, by  
ALEX. DALLAS BACHE,

Chairman of the Com. on Explosions, &c.

Presented to the Board of Managers of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, and approved, September 21st, 1836.

M. W. BALDWIN,

Chairman of the Board of Managers.

WILLIAM HAMILTON, Actuary.

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#### A BILL

*For the regulation of the Boilers and Engines of vessels propelled in the whole or in part by steam.\**

#### TABLE OF CONTENTS.

- SECT. 1. Requires an enrolment, and license of navigation.  
2. Provides a penalty for navigating without a license.  
3. Requires the appointment of an inspector of boilers and machinery, and defines his duties, &c.

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\* The sections of this bill which are taken from that reported by the Committee on Naval Affairs, in the Senate of the United States, at the session of 1835-6, are marked by a note of reference to the sections of the latter.

4. Requires a certificate to the inspector from the owner or master of a steam-boat, of the pressure of the steam intended to be used.
5. Makes provisions intended to secure the safety of boilers.
  - ART. 1. Requires two safety-valves.
    2. Provides for the graduation of the first.
    3. Fixes the maximum pressure to be allowed upon it.
    4. Provides for the regulation of the second.
    5. Requires the second to be inclosed so as not to be accessible except by the captain of the boat.
    6. Puts the second under the control of the captain of the boat.
    7. Regulates the least rise to be given to the lock-up valve.
    8. Directs the form of the lever of the valve.
    9. Provides for each two small cylinder boilers, one set of safety-valves.
    10. Requires a mercurial-gauge for low-pressure boilers, and prescribes its arrangement.
    11. Provides that it shall be open to examination by passengers.
    12. Requires a fusible metal apparatus to be attached to every boiler.
    13. Directs the fusible metal to be inclosed.
    14. Provides for its not being tampered with.
    15. Inspector to compound the fusible metal.
    16. Prescribes the composition of the fusible metal.
6. Requires an examination into the fulfilment of the foregoing provisions, by the inspector, previous to giving certificates.
7. Penalties for interfering in any way with any part of the apparatus provided for the safety of the boiler.
8. Prohibits more than two contiguous boilers to be connected by a water-pipe.
9. Penalties for the bursting of a boiler caused by a deposit.
10. Prohibits boilers in which the metal is exposed to heat without being in contact with water.
11. A thorough examination of the boilers, &c. required of the inspector. Proofs directed and proof-pressure prescribed. Certificates to be given by the inspector to be posted up under penalties prescribed. Fees of inspector.
12. Proofs, &c. to be made every six months. Circumstances under which a license may be forfeited.
13. Requires the pumps for supplying the boilers with water to be kept at work, when a boat is stopped for a temporary purpose. Penalty prescribed.
14. Qualifications for the office of inspector laid down.
15. Penalties for explosions when the master or engineer is engaged in gambling, or is intoxicated. Also from racing, &c.
16. A neglect to obtain or renew certificates as prescribed, to bar from the recovery of a claim for freight or insurance. Owners of boats to be in such cases responsible for loss, or damage, by explosions.
17. Penalties in case of explosion when the captain, &c., has neglected to have the required inspections made and certificates issued.
18. Provides a bounty for boats with boilers on the guards, and suitable bulwarks between them and the interior of the boat.
19. Inspector to be dismissed in case of making false certificates, &c.
20. Provides for the recovery of fines, &c. Proviso, that suits must be instituted within two years after the offence has occurred.

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SECTION 1.\*—*Be it enacted by the Senate and the House of Representatives of the United States of America, in Congress assembled,* That it shall be the duty of all owners of steamboats, or vessels propelled in the whole, or in part by steam, on or before the — day of —, one thousand eight hundred and —; to make a new enrolment of the same under the existing laws of the United States, and to take out from the collector or surveyor of the port, as the case may be, where such steamboat or vessel is enrolled, a

\* Sect.1 of the bill reported in Senate U. S.

new license, under such conditions as are now imposed by law, and as shall be imposed by this act.

SEC. 2.\*—*And be it further enacted*, That it shall not be lawful for the owner, master, or captain, of any steamboat, or vessel propelled in the whole, or in part, by steam, to transport any goods, wares, and merchandise, or passengers, in, or upon the bays, lakes, rivers, or other navigable waters of the United States, from and after the said — day of —, one thousand eight hundred and —, without having first obtained from the proper officer, a license under the existing laws, and without having complied with the conditions imposed by this act; and for each and every violation of this section, the owner or owners of said steamboat, or vessel, shall forfeit and pay to the United States the sum of —.

SEC. 3.†—*And be it further enacted*, That it shall be the duty of the President to appoint at such ports on the navigable waters, bays, lakes, and rivers, of the United States, as in his judgment will be most convenient to the owners and masters of steamboats, and vessels propelled in the whole or in part by steam, one or more persons who shall be practical mechanics, of competent skill, to make inspections of the boilers and machinery employed in such boats and vessels, whose duty it shall be to make such inspections, when called upon for that purpose, to give to the owner or master of such boat or vessel, duplicate certificates of all such inspections, and the said person, so appointed, shall, before entering upon the duties of said appointment, take an oath, before some competent authority, faithfully to discharge and perform the same.

SEC. 4.—*And be it further enacted*, That the owner, master, or captain of each and every boat or vessel propelled in the whole or in part by steam, shall certify, to said inspector, the greatest pressure, or total elastic force, of the steam intended to be produced in the boiler, which certificate shall regulate in the proofs, trials, and construction, hereinafter required.

SEC. 5.—*And be it further enacted*, That each and every boiler of a steamboat, or vessel propelled in the whole or in part by steam, shall be constructed, and arranged, so as to comply with the following provisions:

1. There shall be two safety-valves, each of which shall be competent to discharge the steam made in the ordinary working of the boiler.

2. The first of said valves shall be graduated by the maker of the engine, and have stamped upon the lever, by which it is weighted, the pressure at which it will by calculation open, when the appropriate movable weight is placed at the several marks. Said pressure to be the difference between the pressure of the steam within, and atmospheric pressure on said valve.

3. When the movable weight exerts its greatest pressure, the total pressure upon said valve shall not exceed the pressure as certified according to the provision of the fourth section of this act.

4. The second of said valves, denominated the lock-up valve, shall be immovably weighted, the total pressure upon it not to exceed said certified pressure.

5. Said lock-up valve, with its lever and other attachments, shall be inclosed in a grated box, or otherwise duly arranged so that it can be raised, but not pressed down, except as above provided, upon its seat.

6. Said inclosure, or arrangements, shall be secured with a lock, of which

\* Sect. 2 of bill, &c.

† From sect. 3 of the bill reported, &c

the captain or master of said boat shall alone have the key.

7. Said inclosure or arrangements, shall admit a rise in the valve of at least one-fourth of the diameter of its seat.

8. The lever of said valve shall be so constructed as on the rising of the valve, to diminish the effect of the acting weight, by at least one-tenth of the ordinary pressure derived from said weight.

9. When two boilers, each of not more than forty inches diameter, are connected by a steam-pipe, each pair of said boilers may be furnished with safety-valves, as described in this section, for a single boiler.

10. When the certified pressure provided in section fourth, does not exceed two atmospheres, each and every boiler shall be furnished with a mercurial-gauge, indicating by a float or rod, upon a duly graduated and marked scale, the excess of pressure within the boiler over atmospheric pressure, in inches of mercury.

11. Said gauge and scale shall be so placed as to be readily examined by any and every passenger on board of said boat.

12. Each and every boiler shall be provided with a fusible metal apparatus of suitable form and dimensions, to be applied to the boiler itself, or to its flues, at the place which may be considered that of greatest heat, or most liable to exposure from a deficient supply of water.

13. Said fusible metal shall be contained in a tube to prevent its exposure to pressure, and shall on softening, communicate an alarm by some suitable device.

14. Said apparatus shall be duly secured from being rendered ineffective, in the manner of the lock-up safety-valve heretofore provided.

15. The fusible metal hereinbefore referred to, shall be compounded by the inspector, who shall place it in the apparatus as aforesaid, and shall satisfy himself that the whole is duly arranged as heretofore prescribed; for which service he shall receive, on certifying the same, a compensation of—.

16. The said alloys shall be compounded according to the certified pressure of steam within the boiler, by the following table of parts, by weight, of the ingredients.

TABLE OF ALLOYS FOR USE IN CLOSED TUBES, AND WITH A METALLIC STEM.

Certified pressure in atmospheres.	Tin.	Lead.	Bismuth.	Certified pressure in atmospheres.	Tin.	Lead.	Bismuth.	Certified pressure in atmospheres.	Tin.	Lead.	Certified pressure in atmospheres.	Tin.	Lead.
1½	8	8	7.5	4	8	8	3.4	8	8	6.0	12	8	12.3
2	8	8	6.2	5	8	8	2.2	9	8	9.8	13	8	13.2
2½	8	8	5.3	6	8	8	1.2	10	8	10.6			
3	8	8	4.6	7	8	8	0.5	11	8	11.4			

SEC. 6.—*And be it further enacted*, That before delivering the certificate hereinafter to be provided for, the inspector, heretofore provided, shall examine the apparatus required by section fifth, and shall ascertain that all the provisions of that article are complied with.

SEC. 7.—*And be it further enacted*, That any person or persons whatsoever who shall wilfully overload or otherwise render inoperative said safe-

ty-valve or valves, or render ineffective said mercurial-gauge or gauges, by plugging up or stopping off, or in any other manner preventing their action, or shall in any manner, impair, or interfere, with the usefulness of said fusible metal apparatus, shall for every offence be subject to the penalty of — dollars, and to an imprisonment at the discretion of the court, not to exceed —, and in case of accident to said steam-boiler, resulting from said offence, by which life is lost, shall be deemed to have been guilty of manslaughter, and punished according to law for said offence.

SEC. 8.—*And be it further enacted*, That not more than two boilers of a boat, or vessel, propelled in the whole or in part by steam, and those immediately contiguous, shall have connected water pipes, nor shall the license heretofore provided for, be issued until the inspector has satisfied himself, and has certified, that the provision of this section is complied with.

SEC. 9.—*And be it further enacted*, That for each and every bursting of the boiler of a steamboat or vessel propelled in the whole, or in part, by steam, which shall occur from a deposite of sedimentary matter within a boiler, the master of said vessel, shall forfeit the sum of — dollars; and that in case life shall be lost by the same, he shall be deemed to have been guilty of manslaughter, and shall be liable to prosecution accordingly.

SEC. 10.—*And be it further enacted*, That no boat or vessel propelled in the whole or in part by steam, shall be licensed until the inspector has certified on examination, that no part of the boiler of said boat is, ordinarily, directly exposed to flame, or to heated air from the draught, without the immediate contact of water.

SEC. 11.\*—*And be it further enacted*, That it shall be the duty of the person who shall be called upon to inspect the boilers and machinery of any steamboat or vessel, in conformity to the provisions of this act, carefully, fully, and thoroughly, to inspect and examine the engine and machinery of said boat or vessel, and to state his opinion of their soundness: and he shall, moreover, provide himself with a suitable hydraulic pump, and, after examining into the state and condition of the boiler, or boilers, of said boat, or vessel, it shall be his duty to test the strength and soundness of said boiler, or boilers, by applying to the same a hydraulic pressure equal to three times the certified pressure which the boilers are to carry in steam; and if he shall be of opinion, after such examination and test, that the said machinery and boilers are sound and fit for use, he shall deliver to the owner or master of said vessel or boat, duplicate certificates to that effect, stating therein the age of said boilers, and the pressure of steam which may be carried by them, and which shall in no case exceed one-third part of the proof-pressure, one of which certificates it shall be the duty of said master or owner, to deliver to the collector or surveyor of the port, whenever he shall apply for license or for renewal of license: the other he shall, under a penalty of — hundred dollars for every day that he shall neglect so to do while the boat is running, cause to be posted up and kept in some conspicuous part of the boat or vessel, for the information of the public; and for each and every inspection of the said machinery, and inspection and test of the said boiler or boilers, the said inspector shall be allowed and paid by the owner or master thereof, and before the delivery of said certificates, the sum of — dollars.

SEC. 12.†—*And be it further enacted*, That it shall be the duty of the

\* Sec. 5 of the bill reported in the Senate of U. S. with slight verbal changes.

† From Sec. 6 of the law reported in the Senate of U. S., the period for making the inspections of the boilers, &c., is here proposed to be extended to six months.

owners or masters of said boats or vessels, to cause the examination of the machinery, and the examination and test of the boilers, as provided in the sections of this act, to be made, at least, once in every six months; and to deliver to the collector or surveyor of the port where such boat or vessel, has been enrolled or licensed, the certificate of such inspection; and on failure thereof, he or they, shall forfeit the license granted to such boat or vessel, and be subject to the same penalty as though he had run the said boat or vessel, without having obtained such license.

SEC. 13.\*—*And be it further enacted*, That whenever the master of any boat, or vessel, or the person, or persons, charged with the navigating said boat or vessel which is propelled in the whole or in part by steam, shall stop the motion, or headway, of said boat, or vessel; or the said boat or vessel, shall be stopped for the purpose of discharging, or taking in cargo, fuel, or passengers; he, or they, shall keep the engine of said boat, or vessel, in motion sufficient to work the pump, and give the necessary supply of water, under the penalty of ——— dollars for each and every offence in neglecting or violating the requirements of this section.

SEC. 14.†—*And be it further enacted*, That no other than a practical mechanic who shall be of the age of twenty-one years, or upwards, shall have served two years in a steam engine factory, or general machine making establishment, and who shall have a thorough knowledge of the working of an engine, and shall produce satisfactory testimonials of steady habits, shall be employed as an engineer on board of any boat or vessel propelled in whole or in part by steam, provided that for every violation of this section, the owners or master of said boat or vessel shall forfeit the sum of ——— dollars.

SEC. 15.‡—*And be it further enacted*, That for every explosion which shall happen from any cause whilst the captain, master, or engineer shall be engaged in gambling, or attending to any game of chance, or hazard, or shall be intoxicated, or which shall happen from racing, or from carrying higher steam than the quantity authorized by the certificate, the owner of such steamboat, or vessel, shall be subject to the penalties provided for in the sixteenth section of this act; and the captain, master, or engineer shall be respectively subject to the penalties hereafter provided in the seventeenth section of this act.

SEC. 16.§—*And be it further enacted*, That any owner or master, of any steamboat, or vessel propelled in the whole or in part by steam, who shall fail to obtain, or neglect to renew, the certificates of examination hereinbefore provided for in the several sections of this act, shall be barred from the recovery of any claim for freight or insurance that may accrue when without said certificate, and should any loss or damage to property, or injury to persons, in such case occur in consequence of the breaking of any part of the machinery, or bursting of the boiler or boilers, the owner shall be responsible to the full amount of said loss, damage, or injury.

SEC. 17.||—*And be it further enacted*, That the captain or master of any boat or vessel propelled in the whole or in part by steam, which may not

\* From Sec. 7 of the bill reported in the Senate, &c.

† The Committee propose this section as a substitute for the 16th section of the bill reported in the Senate. That section requiring an examination of engineers by the inspectors.

‡ From Sec. 13th of the bill reported, &c.

§ From Sec. 11th of the bill, &c.

|| From Sec. 12 of the bill, &c.

have been examined, and obtained the certificates required by the several sections of this act, shall in the event of loss or damage to property, or injury to persons, occasioned by the breaking of any part of the machinery, or the bursting of the boiler, or boilers, be subject to a fine of not less than ——— nor more than ——— dollars, and an imprisonment of not less than ———, nor more than ———; and that in event of loss of life being the result of such accident, then said captain, or master, shall be adjudged guilty of manslaughter.

SEC. 18.—*And be it further enacted*, That any boat or vessel propelled in the whole or in part by steam, which shall have its boilers upon the guards of the boat, and shall have between them, and the interior of the boat, or vessel, a sufficient bulwark of timber, or other suitable material, so that passengers shall be protected effectually from injury in the event of explosion, shall be, on a certificate to the foregoing effect from the inspector heretofore provided, exempted from the payment of fees for the taking out of the license of navigation, and shall have remitted one half of the fees for proving and for other purposes of precaution heretofore provided. The fees remitted in such case to be assumed and paid to the respective officers by the United States.

SEC. 19.\*—*And be it further enacted*, That for any false certificate, or one given without the thorough examination contemplated by this act, the inspector herein provided shall be dismissed from office, and fined not less than ——— dollars, nor more than ——— dollars, and imprisoned not less than ———, nor more than ———; and shall be incapable of ever being re-appointed to said office.

SEC. 20.†—*And be it further enacted*, That all penalties, fines and forfeitures imposed by this act, may be sued for and recovered in any court of the United States of competent jurisdiction within the district, or circuit, where the same may have been incurred, in the name of the United States—one half for the use of the informer, and the other half to the use and benefit of the United States.

Provided, That all suits, actions, or indictments instituted, commenced, or found, under this act, shall be commenced or found, within two years after the offence has been committed, or the cause of action accrued.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Description of a machine for Milling Coin, invented and introduced into the Mint of the United States.* BY FRANKLIN PEALE.

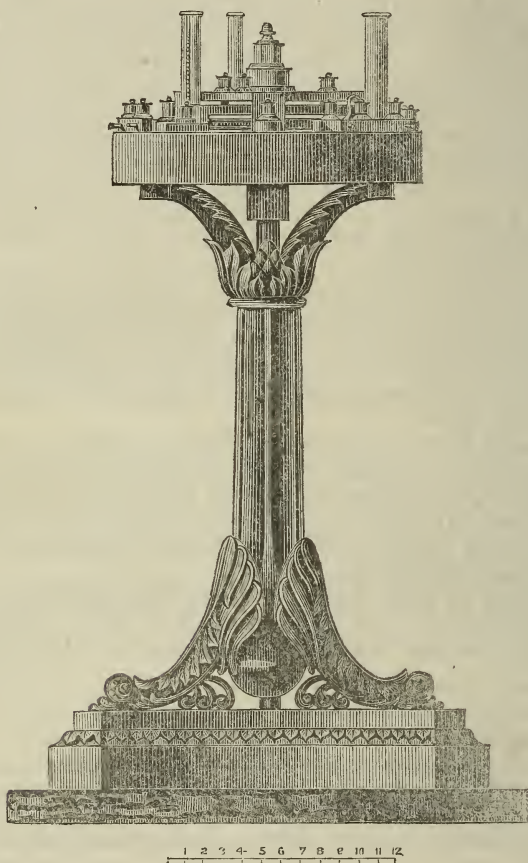
For the purpose of reducing manual labour, and expediting the processes of the Mint, I was induced, during the latter part of the last year, to make designs for the construction of a Milling machine, to be propelled by the steam power ordinarily employed in the Mint, a model of which I had the honour to exhibit at one of the late conversation meetings of the Institute. From these designs and model, the machines to which this communication relates, have been most satisfactorily executed in the workshops of the Mint, and are now in full operation in the coining department.

\* Sec. 17th of bill reported, &c.

† Sec. 18th of bill, &c., with the addition of the proviso at the close of the section.

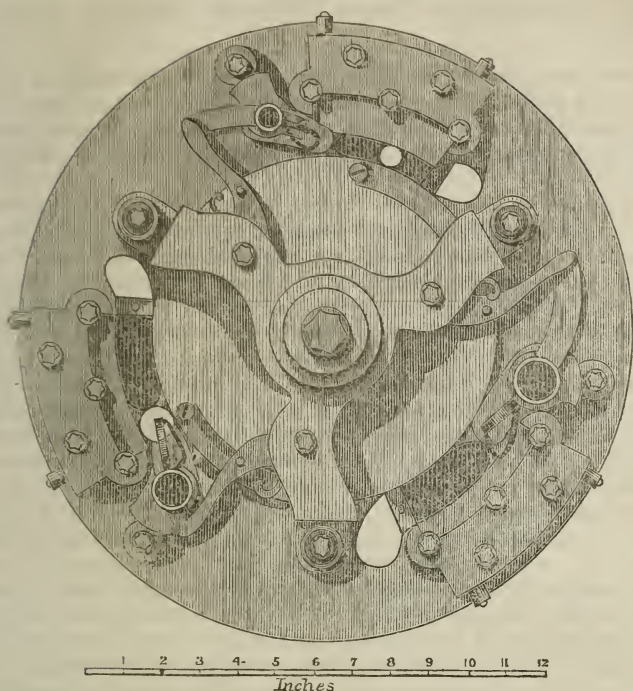
To those who are unacquainted with Mint operations, it will be well to explain, that the operation of milling has for its object, to throw up a thickened edge upon the *blanks* or *planchets*, previous to their being struck, by which means a better border can be given to the coin, with less labour or injury to the dies, it is also, sometimes employed to impress letters or ornaments upon the edge of the coins.

ELEVATION.



A classical tripod, of cast-iron, supports the table on which are placed the feeding tubes and dies; through the centre of the stand a vertical shaft rises from the room beneath, on the lower end of which is a pulley and its band, furnished with a clutch box, by means of which, movement is given, or arrested, as occasion requires. A winch handle may be applied to the hexagonal top of the axis, for the purpose of adjustment, or to propel the machine, if required, by manual force.

## HORIZONTAL VIEW.



Upon the central axis is a wheel, furnished with two steel dies upon its periphery, the length of each of which corresponds to the circumference of the coin to be milled; and on the trilateral spaces of the table, are firmly screwed blocks for the outside dies, furnished with the necessary adjusting screws, by means of which the proper degree of pressure is given. Upon the axis immediately above the central wheel, an oval *cam*, or *eccentric*, is placed, for the movement of the feeders; this cam is set in *time* to place the blanks between the dies, when the extremities of the latter are opposite to each other. The feeders are *levers*, moving on centres, placed on each of the three arms of the gallows which supports the upper ends of the axis; which *levers* are kept against the cam by spiral springs, contained within a cavity at the centre of motion. A circular blade, or *pitcher*, as it is technically called, takes the lowest blank from the pile contained in the feeding tubes, and pushes it forward, at the required moment, and a light curved spring prevents its being thrown in advance of the movement. Nearly all of the parts are exhibited in the annexed views.

This machine is triplicate, and all its feeders may be put in motion at the same time, or any one of them, as occasion may require. Each division is capable of milling 200 pieces, or more, per minute, equal to 12,000 per hour, with the attendance of a boy only; and during this rapid operation, separates any defective pieces that may pass into the tubes. This machine has been in operation since February of the present year, and has given unqualified satisfaction in every respect.

*Observations on Microscopic Chemistry.* BY JNO. W. DRAPER, M. D. *Professor of Chemistry and Natural Philosophy, Hampden Sidney College, Va.*

1. One of the greatest obstacles to a more general study of scientific chemistry, is a prevailing opinion, that of all the various branches of knowledge, this demands more diversified resources, and entails upon those who prosecute it, an expenditure, usually beyond the means of private individuals.

2. It therefore is the duty of those who wish well to the science they cultivate, to point out the error of such an opinion. Within a few years there has been a complete revolution in chemical manipulation, or the mode of making experiments; a change, to which we are to ascribe the present rapid advance of the science. Operations on the large scale, are never performed, except by those who are public teachers, and here the necessity of rendering effect visible at a distance, calls for a degree of magnitude in experimenting, that unfortunately leads the pupil to conclude, that such pursuits can only be followed by the possessors of large fortunes, and even that they would meet with "almost impossibilities," except they were residents of cities. Those large retorts, and bells, and complicated stop-cocks, and furnaces, the innumerable company of vials, and tests, and electrical machines, and galvanic batteries, could not be purchased in the country. This is a conclusion to which those who have a predilection for these studies are often led,—an unfortunate conclusion, for it restrains many a one who would otherwise be an active and efficient labourer in the field. Now, there are few chemists, even among those who reside in cities, and have the disposal of well appointed laboratories, who could not communicate a large stock of highly useful information to their less fortunate brethren. A man, who for a number of years, has been engaged in all kinds of operations of repetition and research, must of necessity be acquainted with a number of simple succedanea, both in the shape of operations and instruments, which at times have obtruded themselves upon his necessities. With this view, I propose to offer my mite, in the hope that it may stimulate others, who are far better able to extend this kind of information.

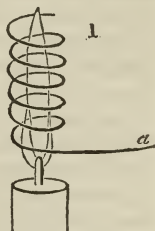
3. The specific properties of any kind of matter, are as well seen in a small particle as they are in a large mass. A piece of marble, not bigger than a pin's head, will furnish the same chemical results, as a piece of an ounce weight. Hence, if the operator possessed that delicacy, and tact which would enable him to work as well with the small quantity as with the large, his result would be equally striking, and equally true. Like all other sciences, in its infancy chemistry had a degree of roughness, which offers a remarkable contrast with the neatness and finish of modern manipulation; instead of those enormous alembics, and colossal retorts, which dignify the works of the earlier writers, we now give instructions to perform the same distillations in fragments of quill tubes; the blow-pipe has replaced the hundreds of blast, and forge, and reverberating furnaces, over which the alchemist toiled, by the sweat of his brow, not, alas, gaining his bread; and the grain weight and cubic inch have become the units of the laboratory, instead of the pound and the gallon.

4. The manipulation of microscopic chemistry, consists in the art of working with small portions of matter. It requires a degree of manual dexterity which practice alone can give, but which if once gained, is of vast importance to the chemist. It reduces, to an indefinite extent, the charges

and expenses he incurs in a series of experiments; and, what is equally valuable, there is a great saving of time. A few minutes will often put him in possession of the same facts, that on the old plan he must have been hours or days in acquiring. Again, there are often circumstances under which he would be compelled to work on minute quantities, as perhaps in the detection of a poison in the stomach, or in the analysis of a precious substance, and here if his previous habits had not accustomed him to operations on the small scale, he would soon find himself quite incompetent to perform his task. In this point of view, perhaps future chemists will hereafter assign a much higher rank to Dr. Wollaston than to Sir H. Davy, the simple, refined and delicate experimenting of the former, affording a more useful guide than the dashing brilliancy of the latter.

5. It is not many years, since the mouth blow-pipe was transferred from the workshop of the jeweller, to the laboratory; it has already become one of our most powerful and useful implements, giving a command over a range of temperature nearly as high as the melting point of wrought iron. Still later the simple candle or lamp has been employed, without any means of urging the flame, and when properly managed, its applications are also very extensive; to the chemical student, it is an invaluable substitute for all kinds of extensive furnaces, and therefore deserves to be thoroughly understood. As there are many parts of the United States, where oil is with difficulty obtained, and lamps scarcely ever used, I propose first to make a few remarks on the power and method of using a tallow candle, as a source of heat.

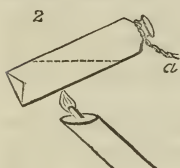
6. The range of temperature that can be commanded by a tallow candle, is by no means inconsiderable; it is well known that iron or steel filings sprinkled on the flame, are made at once white hot. And if a copper wire be presented to it, under certain circumstances, it will be fused in a few moments. This is a simple experiment, but one well deserving of repetition; so far however as I am aware, it has never yet been pointed out; it is striking, and perhaps in the hands of a skilful machinist, might have some useful applications. A thin copper wire, is to be bent into a spiral of six or eight turns, over a cylinder of wood, about the size of a black lead pencil; one end is left uncoiled as at *a*, to be used as a handle; the spiral is now to be put over the flame of a candle, whose wick has been fresh snuffed; it is to be arranged so as entirely to surround the flame, and held by the extremity *a*; the flame immediately, burns very dimly, and puts on a greenish hue, and the copper wire melts and falls down. So complete and perfect is the abstraction of the heat from the flame, that I doubt not that if a narrow tube were placed under similar circumstances, and a stream of water forced with great velocity through it, it would be an advantageous mode, if not the most advantageous, of applying flame as a source of heating liquids.



7. A great variety of experiments are required, respecting the fusibility of minerals or other substances, and the characters they display in the fire; these for the most part, may be made by paying due attention to the size of the fragment operated on, viz. that it shall be sufficiently small, and that the support on which it is presented to the flame, be as fine as possible, and of a highly non-conducting material. It is the perfect fulfilment of these conditions, that enables a simple candle flame to burn iron filings. A little

cone made of white clay, and having a very fine point, is excellent in these respects, and is useful also in blow-pipe experiments.

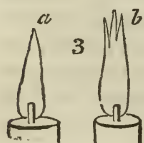
8. There are certain minutiae to be attended to, in working with a candle, that should here be noticed. They arise from the candle burning with a flickering flame, from the wick becoming too long and smutty, and requiring continual snuffing. This last inconvenience, may, however, be avoided by a simple expedient. Suppose it was required to dissolve a certain quantity of any saline substance in boiling water, and that to effect the solution, would require the application of heat for several minutes. Having beaten the salt into small fragments, put it into a common vial, of such a size, that the amount of liquid shall not half fill it. Around the neck of the phial, double a strip of paper, the projecting ends of which are to be twisted into a handle, *a*. Now, if the candle be held in a vertical



position, it will be found, that it would require continual snuffing at inconvenient moments; but, by inclining it at an angle to the horizon, as soon as the wick exceeds a certain length it projects beyond the edge of the flame, and is burnt off, by the continual access of atmospheric oxygen, and the candle never requires snuffing. In the operation before us, it will be found unsafe to apply the flame to the extremity of the phial, because nearly all phials are very thick in the bottom, and fracture would certainly ensue; but, by applying the heat an inch higher up, all kinds of solutions, distillations, &c., may be safely, cheaply, and expeditiously performed by this means. In the course of a few minutes, the liquid commences boiling, and the solution gradually proceeds; steam is copiously evolved from the mouth of the bottle, and the whole vessel attains a temperature which renders it inconvenient to touch; the advantages of the twisted paper handle are now apparent, since the vessel may be held in the hand, the elbow resting on the table, while steam is copiously rushing out of it, and all the phenomena of the solution distinctly seen.

9. In this, as well as all similar operations with candles, and also with lamps, there is an important observation to be attended to—it refers to the distance between the bottom of the vessel, and the top of the flame. It might be supposed that a maximum of temperature would be reached by plunging the vessel into the flame; such, however, is not the case; a copious deposit of carbonaceous matter at once covers the surface, and the high radiating power of this coating, exerts a powerful cooling effect. Nor is that all; every thing like cleanliness is entirely sacrificed; if the fingers happen to touch it, they become soiled, and it is impossible to see the action going on in the materials employed. All these inconveniences are avoided by placing the vessel half an inch, or if the flame flickers much, a whole inch above its apex; the cleanliness of the vessel is insured, there is an abundant supply of heat, and the operator can distinctly see any kind of reaction going on in the materials. It may be observed that these remarks do not apply to the spirit lamp.

10. When a candle thus arranged, is burning as it ought to do, its apex is not a cone, as *a*, but is as represented at *b*, ending in a kind of three pronged fork; the point of maximum available temperature, being about half an inch from the tips of the prongs. In an appropriate, but very simple arrangement of phials, such as will be shortly pointed out, evaporation and distillation to a certain extent, may thus



be carried on over a candle; the distillation of water, or the making of strong nitric acid, are thus readily accomplished. Except, however, when the vessels are exceedingly small, it will not be possible to distil sulphuric acid, or mercury, too high a temperature being demanded.

11. Where oil is readily procured, the common oil lamp is a much more convenient implement than the candle, affording a more steady and constant flame, which can easily be protected from the agitation of currents of air, by a piece of sheet tin, two inches wide and three long, bent into a cylindrical form. This chimney ought to have its lower edge serrated, to admit a copious afflux of air, and at the same time to stand firm on the lamp. Sheet tin, or copper, or brass, can be readily cut by a common pair of scissors, and that elasticity which sometimes hinders a piece from retaining the shape into which it may be bent, is overcome, by making it red-hot in the fire.

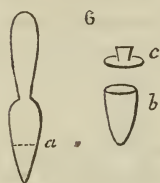


12. I have somewhere seen a description of a small portable furnace which is used by the Cingalese jewellers, and found it very eligible in experiments which demand the ignition of a larger mass than can be worked either with the simple candle, or blow-pipe. It consists of a shallow earthen tray; of the size and figure of a saucer, which is to be filled with sawdust, or finely chopped straw. On the surface of this non-conducting bed, a little charcoal fire is raised, one of the pieces of coal having been previously ignited. The fire is urged by blowing at it, through a piece of hollow reed, or tobacco pipe stem, or even through a straw; there is a certain distance, at which the pipe has to be held, to produce the most powerful effect, this is easily determined at the very first trial, by a peculiar roaring sound that the blast makes among the embers; this distance varies from 2 to 6 inches, depending on the degree of ignition, and the force with which the wind is urged. Gold, silver, and copper, may be melted in this furnace, when the fire is about as large as one's fist, and the igniting and crucible operations required in mineral analysis, may be conveniently performed in it.



13. The bowl of an earthenware tobacco pipe, makes a suitable crucible for this furnace, the hole in the bottom of it being stopped by a pellet of clay. Persons, however, who reside where refractory clay can be procured, will find it convenient to accustom themselves to the manufacture of small vessels, such as crucibles, tubes, retorts, &c. And as knowledge of this kind gives a degree of independence to a chemist, affording him facilities for working without a long and vexatious delay in having to send to the cities for suitable implements, it is well for him to make himself master of it; the process for forming a crucible is as follows. A piece of wood, six or eight inches long, and of a suitable thickness, has one of its ends cut into a shape suitable for the inside of the vessel, it is finished off neatly with a file, and no projecting part, or asperities, left; it should be considerably longer than the height of the intended crucible. The clay is to be prepared, by picking out from it any little pebbles, grit, or any other impurity, and bring it by kneading with a due quantity of water, to the condition of a stiff homogeneous paste. A small cylinder of it, is then to be rolled out on a board, until it is about one-sixth or one-eighth of an inch thick, observing not to roll it out entirely on one side, but after having

passed the roller, (which may be a piece of stick rounded, or a common rule,) two or three times on one side of it, to shave it up, by passing a knife between it and the board, and then turning it over, to roll it on the opposite side; by this means it is prevented from sticking to the board. The core *a*, fig. 6 having been slightly greased with lard, is then covered with a sheet of the clay, as high as *a*, the seam where the two edges meet is neatly united by pressure with the fingers, and also the bottom closed. Care must be had, that not too much clay be put on the core, or the work will be bungling and clumsy, it will therefore be



evident, that the size of the sheet laid on, should be properly adjusted. The core can be removed without any injury, by claspings the crucible all round with one hand, and twisting at the wooden handle with the other. As the clay slips off, the pressure must be relaxed, for fear it should be crushed. A degree of polish may then be given, to the inside and outside, by rubbing them gently with a wet finger, and the upper edge neatly rounded off; and if necessary, a beak made as at *b*. No difficulty will be met with in thus making crucibles up to an inch high, and half, or three-quarters in diameter. A few lids for them, shaped as at *c*, should also be prepared.

14. In like manner, tubes may be moulded on a cylindrical stick, but when they are over a certain length, difficulties arise in slipping them off, a part of the clay moves, but the rest adhering, disfiguration ensues. For long tubes, and also for retorts, it is therefore better to form a core of bees-wax, by moulding it in shape between the fingers, the clay is then to be applied, and when dry, the wax is to be melted out. Those who are adepts at this kind of work, will have no difficulty, however, in moulding a retort on a piece of wood, cutting it into symmetrical halves, with a pen-knife, taking it off the core, and applying the cut edges again together; it is to be remarked, that the core must in no instance be anointed with too much grease; it will hinder cut edges joining, if it should get upon the junction.

15. Vessels thus made are very porous, and therefore unfit for many uses. They may be glazed, by covering them with a paint, made of a mixture of lime, borax and water, applied with a common brush. The greatest difficulty, however, in manufacturing them, consists in drying them thoroughly, without cracking; the desiccation must be very gradual, and equal; first, dry them in the sun, and then approach them slowly to a fire; some clays are more prone to crack than others, and the addition of fine sand to them is a great advantage; but the process of drying, must still be carried on cautiously. When once, however, they have been made red-hot, all further danger on this account is over; at a temperature slightly higher, the lime paint daubed on melts into a glass, which soaks into every pore and renders all quite tight.

16. To show the extensive application these homely little vessels have, I may remark, that I have seen one of them, a retort, whose belly was not larger than a school-boy's marble, and neck three inches long, when properly glazed, and charged with the carbonaceous matter that results on igniting cream of tartar in close vessels, filled with the green vapours of potassium, when placed in the furnace of sec. 12; a proof of its tightness and applicability.

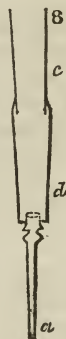
17. Very useful glass vessels, for distillations, sublimations, &c. may be made out of apothecaries' phials. One of these will serve for a retort; and

another, with its neck cut off, for a receiver: the object of cutting the neck off, being to give entrance to the mouth of the other phial. The readiest way for a beginner to cut glass for these purposes, is by a hot wire laid on the place where it is desired to cut the vessel; in a short time the glass cracks, and the seam will follow the hot wire in any direction; should it refuse, however, to do so, it is because the wire has become too cold. Some kinds of glass are rather tardy in cracking, they may, notwithstanding, be forced by putting a drop of cold water on them, when they have become hot from the touch of the wire; but this expedient has the disadvantage of often starting the vessel.



18. In the books, there are descriptions given, of different methods of igniting gaseous mixtures in close vessels, one of the most usual is by an electric spark; this spark may be procured from the machine, or by an electrophorus made of glass or rosin. There is a substance which, it appears to me, might be very serviceable for the construction of both these instruments. Common, strong, brown paper, is one of the very best electrics we possess, as the following experiments may prove. Take a piece of this substance, ten inches long and four broad, and holding it in the left hand by one end, lay it upon the right knee, placing the right forearm with a gentle pressure upon it. Draw it from between the knee and arm, replace it, and repeat the operation. Then, on approaching a knuckle to it, a spark an inch or two long will be projected from it, with a very audible crack. Or, if it be placed on the side of the wall, it will adhere there. Or, if when thus excited, it be brought over small paper figures on the table, they will dance beneath it. To the success of these experiments, two precautions are required; the paper must be dried before the fire, until it smokes, and the garments must be made of woollen cloth.

19. For attaining high temperature in the interior of jars and glass globes, there is no simple and effectual contrivance; this is yet a desideratum. The solar convex lens is excellent in its way, but it is too dependent on the weather for its action, and too expensive for common use: the igniting effect of a voltaic arrangement, is only to be taken advantage of by those who have powerful instruments at their disposal. Wherever the impression of a powerful heat, under ordinary circumstances is required to be observed, the blow-pipe is of very advantageous use. This instrument, in its simplest form, consists of a straight pipe terminating in a narrow, but neatly rounded aperture *a*. It may be made of almost any material; as of a reed, or a couple of quills slipped on one another; its essential part being the small beak, or termination, which ought to be formed of some infusible metal. On an emergency, the young chemist may make a very useful and excellent instrument, by taking two quills, as *c* and *d*, and slipping the one a short way into the other, and forming the beak, or termination of the extremity, of one of those patent silver pencil cases, which are now in such general use. This may be fitted air tight to the quills, by wrapping paper round it, and is much superior in its action, to many of the brass blow-pipes sold in the shops. These blow-pipes are generally bent, and those who are in the habit of using them consider that as an advantage; but in mineralogical



investigations, there are several advantages in the instrument being straight, the flame is thrown from the operator's face, and he has a better view of the action going on in the materials with which he is experimenting. When glass tubes are to be had, a temporary but very excellent blow-pipe may be made, by drawing out one end of a piece, four or six inches long, to a point, and cutting it off, until the reduced aperture is of a proper size; it requires however, care to be taken, that the fine extremity be not held in the flame, except when the current of air is passing through it, or the temperature suddenly rises, the glass fuses, and the pipe becomes sealed.

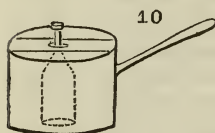
20. Occasionally, experiments have to be made when a more exalted temperature has to be applied to a glass vessel, than can be conveniently attained by means of a candle or lamp. If, for instance, it were required to boil an ounce or two of the common brown sulphuric acid of commerce, so as to render it colourless, the operator would not find it convenient to make use of any of the arrangements hitherto described, for there is always more or less risk, in exposing a glass or phial to the naked fire; a risk, too, which it is not desirable to incur, when so highly corrosive a substance as hot sulphuric acid is concerned. The danger of fracture, and its consequences may, however, be avoided, by means of a bath of sand. In all well regulated laboratories, this forms a standing part of the fixtures, though as far as I have observed, it is less used, and its convenience seems to be less understood in this country than in Europe. A very good extemporaneous one, suitable for the purpose here described, may be formed out of a common frying pan, filled with coarse sand, that is free from dust.



An apothecaries' phial, the bottom of which is thin, may have the sulphuric acid poured into it; it is then to be placed in the sand, so as to be half an inch from the bottom of the pan, and the sand piled round it, not, however so high as to be above the level of the fluid, for fracture will then be liable to occur; thus

arranged, the pan may be placed on a clear fire, and the operation satisfactorily performed. Several liquids, as sulphuric acid and alcohol, boil with a kind of explosion, and not in the quiet tranquil manner that water does. A few shivers of glass, or pieces of platina foil, prevent this irregularity. By means of a sand bath, all temperatures may be commanded, from low redness, downwards.

21. Water baths, and steam baths, are also occasionally very serviceable, and very easily constructed, by means of utensils employed in domestic



economy; a common tin saucepan, is a convenient vessel for this purpose. It should be filled with water to a suitable height, and the phials containing the material to be exposed, fixed in it so as not to be overturned by any violence in the ebullition; this may be effected by passing their necks through a piece of wood, long enough to fit tightly into the sauce pan.

## Franklin Institute.

### *Quarterly Meeting.*

The fifty-first quarterly meeting of the Institute was held at their Hall, on Thursday evening, October 20th, 1836.

THOMAS FLETCHER, Vice President, presiding.

CHARLES B. TREGO, Rec. Secretary, pro tem.

The minutes of the last quarterly meeting were read and approved.

Donations of Books were presented by Matthew Carey, Esq., R. C. Taylor, Esq., George Fox, Esq., Hon. James Harper, Isaac Hays, M. D., Robt. Hare, M. D., Prof. Alex. D. Bache, Messrs. Carey & Hart, D. Moulson, John Abbott, of Philadelphia; Timothy Claxton, Esq., of Boston, Mass.; Prof. B. F. Joslin, of Albany, New York; Prof. John R. Cotting, of Taunton, Mass.; the Society instituted in London for the encouragement of Arts, Manufactures and Commerce; Francis Baily, Esq. and Petty Vaughan, Esq. of London.

Donations to the Cabinet of Minerals, &c., were presented by Messrs. Felix Fossard, Rufus Tyler, and John L. Pearce, of Philadelphia; Calvin Mason, of York, Pa.; Timothy J. Dyre, of Fair Haven, Mass.

Prof. Franklin Bache presented a machine for dressing printers' types, formerly the property of Dr. Benjamin Franklin.

The Actuary laid on the tables the periodicals received in exchange for the Journal of the Institute, since the last meeting.

The Chairman of the Board of Managers presented the fifty-first quarterly report of the Board to the Institute, which was read and accepted; on motion, it was referred for publication.

The Treasurer presented his report of the finances of the Institute, for the quarter ending September 30, 1836, which was read and accepted.

Extract from the minutes.

THOMAS FLETCHER, *Vice President.*

CHARLES B. TREGO, *Rec. Sec., P. T.*

### *Fifty first Quarterly Report of the Board of Managers of the Franklin Institute.*

The transactions of the past quarter of the year, furnish but little new matter to be communicated to the Institute, as it has been marked only by the prosecution of the general scientific inquiries in progress at the last meeting, and in making preparation for the active duties of the approaching season. The second part of the Report of the Committee on the explosions of Steam Boilers, has been completed and published, and contains an elaborate scientific explanation of the causes of such disasters, and manifold directions and cautions by which they may in a great measure be avoided. A bill has also been prepared to be submitted to Congress at their next session, to enforce the use of the protective measures which the Committee have deemed important, to give perfect security in the use of so valuable an agent as steam. It is hoped that the return of the gentleman to whom the results of the experiments on the strength of the materials employed in steam machinery were confided, for the purpose of making a report thereon, will very shortly enable him to complete it, and when that shall be accomplished, the people of the United States will be put in possession of information on the interesting subject, embraced in the investigation, of

incalculable value to their commerce and manufactures. The Report on the subject of Water Power is still in hand, and will be published as soon as the complex nature of the calculations will permit.

The committee of the Institute appointed under a resolution of the General Assembly of the State of Pennsylvania, for the purpose of making the necessary scientific observations, to fix the standards of Weights and Measures for the Commonwealth, have been requested by the Governor to superintend the construction of the standards themselves; little has yet been done on the subject, but the zeal which has sustained our committee in the arduous experiments on water and steam, will not fail to secure for our own State a system of vast importance in the distribution of the heavy metals and minerals, which now form so large a portion of her trade. Passing from subjects of a more general nature, to those in which the members of the Institute are more interested, we have great pleasure in stating, that our able and accomplished Professors, Mitchell and Johnson, will commence their lectures on the first Monday of November next, and that they have made preparations for courses of more than common interest. The Committee on Instruction have also secured the services of Mr. Booth, whose interesting lectures on Technology were so much esteemed last winter, and he will give, on Friday evening of each week, a course of instruction on Chemistry, applied to the Arts, embracing the processes employed in the preparation of many articles of importance in domestic economy, which cannot fail to be highly valuable and instructive to the class. Our Drawing School will continue under the care of Messrs. Mason and M'Clure, and will open in a few days. Of its success under their management we have no fears, and with the full conviction that it is only necessary to announce the opening of the School, we leave it to the patronage of the members and the public. The Committee on Instruction feeling a deep interest in the success of the Evening English School, established about four years ago, have thought that a reduction in the price of tuition would obtain for it a more liberal patronage, and have accordingly proposed to the very estimable gentleman who has conducted it, to charge three dollars per quarter, instead of five dollars, requiring the pupils to furnish their own lights and stationary. His answer has not yet been received, but should it be favourable to the change, the Committee will make an early public announcement of the fact; if, however, he should decline undertaking it on the terms proposed by the committee, it will not be advisable to open it with the scanty number of pupils who have hitherto attended. To the Cabinets of Models and Minerals, and the Library, several additions have been made, and the Board would here notice the very liberal donations of money which have been placed at their disposal, by the members, for the purpose of being invested in Books and Apparatus, by our much esteemed member, Professor A. D. Bache, now on a mission to Europe. The Committee on Science and the Arts, are still actively engaged in the examination of the numerous machines which the fertile ingenuity of our countrymen is daily bringing forth, and is realizing all the advantages promised by its establishment in bringing the theoretical and practical mechanics of the Institute together, on a field where they can be mutually benefitted.

Owing to the unusual demand for money which has been experienced for some time past in this city, the Committee on the New Hall have not yet been able to negotiate such a portion of the loan authorized by the Institute, as would warrant them in commencing the erection of a more commodious edifice for the purposes of the Institution, and though our means

of extending still further the usefulness of the Institution will be somewhat cramped by the necessity of providing the funds requisite to meet the interest accruing on the debt to the Grand Lodge, for the purchase money, yet the Board feel assured, that an institution so intimately connected with the Mechanic Arts, will not be suffered long to labour under a disadvantage entirely pecuniary.

The same zeal which has given it upwards of 2000 members, and hitherto sustained it under more trying circumstances, will still continue to animate its members, and in a few years more, endeared to the public as well by its important services in the cause of education, as by its invaluable investigations of the most important practical and scientific objects, the name of the Franklin Institute will convey a highly exalted idea of national greatness, and stimulate our sister institutions to a greater zeal in the promotion of the Arts and Sciences.

M. W. BALDWIN, *Chairman.*

WILLIAM HAMILTON, *Actuary.*

The Second Monthly Conversation Meeting of the season was held at the Hall of the Institute, on the 27th of October, 1836.

The attendance was very full, and the meeting one of much interest: upon the table were some excellent specimens of wood engravings, executed by Mr. Reuben S. Gilbert; and a new working model of a compound screw press, for packing cotton, &c., invented by Mr. Joel Barns.

Messrs. Wallace, Chandler & Co., presented a beautiful specimen of iron casting, in imitation of the celebrated Berlin castings, from the foundry of Messrs. Crocker & Richmond, Taunton, Mass.

Messrs. Greenough & Farnum submitted for inspection, several pieces of white flannels, of superior quality, and said not to shrink in washing; manufactured by the Ballard Vale Company, Andover, Mass.

Mr. Philos Tyler exhibited a wheel tire, the inner surface of which was deeply indented by the grain of the wood composing the wheel: this phenomenon elicited from several of the members some curious and valuable information relative to the effect of great pressure upon metals and other hard bodies.

Toward the close of the evening, Mr. James P. Espy communicated a brief, but very interesting, explanation of some meteoric phenomena, of frequent occurrence.

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## Mechanics' Register.

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### AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1836.

*With Remarks and Exemplifications by the Editor.*

(CONTINUED FROM PAGE 329.)

61. For making *Vegetable extracts*; Thomas Close and John C. Sandford, Rye, West Chester county, New York, March 18.

"The process consists in forcing through the cut, bruised, or powdered, particles of vegetable substances, a volume of steam, water, or other liquid, under and by a pressure, varying in intensity, according to the nature of the substances to be acted upon."

This patent is not taken for any particular form of apparatus; but a description is given of one which is considered and claimed as new. The pressure is to be continued for a longer or shorter period, according to the nature of the substance to be acted upon, and it is said that "the colouring matter, tannin, and other soluble parts of the wood or vegetable substance will be immediately and perfectly extracted, and with the use of a much less quantity of water, and in much less time than would be required by the ordinary process of boiling, infusion, or steeping, leaching, &c."

The patentees claim to be "the original discoverers and inventors of the art of extracting the soluble parts of vegetable substances, by means of the heavy pressure of steam, water, or other fluids, exerted upon and through the materials to be acted upon, however the pressure may be effected. Also the combination of the chamber and perforated lid as described; the combination of the boiler, water pipe, and steam pipe, with said chamber, and its said apparatus for the purposes aforesaid."

The whole process is well described, and we are not aware of any theoretical, or practical, objection to it; but, on the contrary, it appears to us that for many purposes it may be used with great advantage.

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62. For a *Portable Cooking Stove*; Charles Vale, Newark, Essex county, New Jersey, March 18.

This stove, it appears, is intended to cook by means of anthracite, or charcoal, as fuel; but we are unable, from the description and drawing, to form any clear idea of its construction and use. There are letters of reference used, and figures referred to, in the description, which are not to be found in the drawing; we therefore must dismiss the affair.

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63. For an improvement in the *Art of Tanning*; Henry C. Locher, Lancaster, Pennsylvania, Administrator of Henry Locher, deceased. March 18. (See specification.)

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64. For an improvement in the process of *Manufacturing White Lead*; Horner Holland, Westfield, Hampden county, Massachusetts, March 18. (The specification will hereafter appear.)

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65. For a *Hemp Brake*; John Pursell, Perryville, Mercer county, Kentucky. March 18.

The Break is made in the ordinary form, the patented improvement consisting in working the vibrating swords by means of a treadle, in the downward stroke, and in raising them by means of springs.

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66. For apparatus for *Worming and serving ropes*; Adam Montgomery, city of New York, March 18.

By means of this apparatus, four strans of rope yarn are to be served at once. The yarn is wound upon a kind of bobbin or tube, with heads, through the centre of which the rope passes, and the heads of which are large, to enable them to contain a sufficient quantity of yarn. The tube of the bobbin projects beyond the heads, and on one end a weight is suspended to give a proper tension to the yarn; against the other, the worming, or serving, mallet works, and is turned by hand in the usual way. There is a tube on the end of the handle, and at right angles to it, through which the yarns are conducted in their passage to the rope, whence they pass

through holes in a piece of metal projecting from the head of the mallet, and guiding them into their places on the rope. When used for worming, the hollow of the mallet is to be faced with metal, forming a segment of a female screw. When used for serving, the mallet has a plane groove, as usual. The claim is to "the before described apparatus for worming and serving ropes, and the manner of operating the same."

In the 29th volume of the 2nd series of the Repertory of Arts, there is a description of a machine very similar to the foregoing, but nothing is said about winding several strands at once. This, as an improvement, would have been a proper subject for a patent.

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67. For *Manufacturing Salt from salt water*; Richard K. Cralle, Lynchburg, Campbell county, Virginia, March 18.

A very full description of the apparatus employed is given in the specification, after which the patentee says, "What I claim as my own invention, not heretofore known or used, in the above described machine, is the application of the principle of evaporation *in vacuo*, to the manufacture of coarse and common salt. I claim to have invented the means of applying a known principle in physics, to the new and useful purpose of salt making. The machine described, so far as its construction is peculiar to the purpose above, I claim as my own invention. The machine may be varied in construction, and the principle applied in other modes; but I claim to be the original inventor of the means of applying the principle of evaporation *in vacuo*, to the manufacture of coarse and common salt."

The apparatus, as shown in the drawings, is intended merely to exemplify the principle, and not to furnish a definite arrangement; the description of it is elaborate and clear, but we find nothing to designate in what "its construction is peculiar to the purpose;" and therefore cannot tell what is claimed; this ought to have been distinctly set forth, as, in our opinion, it would form the only foundation for a valid claim. It has been decided that the application of a known machine to a new purpose is not patentable. To apply the same mode to the evaporation of water from a solution of salt, which has been applied so extensively to its evaporation from a solution of sugar, cannot fairly be called an invention, however useful it may be. If geese had never been roasted, although turkies had been usually cooked in that way, a patent for roasting geese would hardly be sustainable.

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68. For a *Metallic Mill*; Joseph C. Gentry, Dayton, Montgomery county, Ohio, March 18.

A cast-iron cylinder is to be banded, or otherwise covered, with cast-steel, then turned smooth, and picked with a pointed, steel tool. A concave of cast-iron, forming nearly a half circle, is to be adapted to the cylinder; and ribs, or bands, of cast-steel, projecting about one-sixteenth of an inch from its surface, are to be inserted in dovetail grooves, extending the whole length of the concave; these also are to be filed on their surfaces. The concave must be sufficiently open at one edge for feeding, and the cylinder is to be held down by springs, to prevent injury from the introduction of hard substances.

"What I claim is the steel or other metallic ribs, and the manner of fix-

ng them in the concave. And the cast-steel or other suitable metal, plated or banded on the cast cylinder. The manner of relieving the action of the cylinder by springs back of the boxes, on which the journals rest. The manner of picking the cylinder and ribs, presenting the sharp edges to each other, as described above."

Such a mill would be costly, easily put out of order, and difficult to repair. We are very apprehensive, also, that, when in the best order, it would not make very good flour. The claims embrace too many individual parts of the mill, some of which would not be able to stand alone.

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69. For a *Mortising machine*; George Page, Keene, Cheshire county, New Hampshire, March 18.

The general resemblance in principle between this and some mortising machines which have preceded it, is such as to leave little apparent room for a claim, and it does not occupy a large space, being to "the mode of attaching the slide to the upper lever and that lever to the machine; and also the lower box, and circular brace as described." We shall not take time to describe these particulars, but have no doubt that they are equally good with other modes of attaining the same end, and that the machine, if well made, will work well.

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70. For a machine for *Cleaning and Dressing Feathers*; Elam Wilbur, Geneva, Ontario county, New York, March 18.

Feather dressing machines bid fair to become as numerous as churns and washing machines, whilst, so far, they differ as little from each other as do a number of the former instruments. The claim in the present case is to "the steam chamber for generating steam in a separate chamber, or chest, from the case in which the feathers are placed; and the wings for blowing out the feathers at the door at which the opening in the ticking is placed to receive them."

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71. For a *Door Lock*; James M'Clory, City of New York, March 18.

The claim made is, to "the guards, the plates of tin placed between them; the levers and bar; the application of a double bitted key to this lock, and the mode of operating the several parts."

The drawing gives a very imperfect representation of this lock, and the claims extend to things which have no novelty when taken individually, as is done in the foregoing summary. The guard, are flat plates of metal laying upon each other, and operated upon by the key; the cam, or bit, of which is in steps, so as to push the plates to different distances, in disengaging the bolt. Double bitted keys have been frequently used; the mode of operation in some of the parts is new, but this is not the case generally. The lock is probably a very good one, and we believe that it has sufficient novelty to admit of a sustainable claim.

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72. For a method of *Making Pitch*; Henry Ruggles, city of New York, March 19.

The refuse, or tar, such as is left in making gas in the New York gas works, is to be boiled down to the consistence of pitch, and then put into barrels.

"I claim the exclusive privilege of boiling down, either in an open or

close vessel, kettle or still, the liquid such as is produced at the New York gas house, in the manufacture of gas, and known there by the name of refuse, until it becomes of the thickness, or consistency, of pitch."

The distilling of the spirit from the refuse, or tar, of gas works, so as to reduce it to the consistency of pitch, is a common and well known process in London, and in other places where there are large gas works; the *exclusive* right, therefore, is not likely to be conceded.

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73. For *Backs of stoves and fire places*; William R. Prescott, Hallowell, Kennebec county, Maine, March 19.

A tube of suitable diameter, say nine inches, and two or three feet long, is to be built in the back of a fire place, or fixed, in any convenient way, in a stove; a tube, of about two inches diameter, is to lead from without the room, into this longer tube, to supply it with cold air, and warm air tubes are to lead from either end of it, into the room, to afford a supply of warm air.

The claim is "to bringing, in the manner described, the cold air from without the room to which the fire place is situated and supplying it to the stove, and of thus keeping up a circulation of cold air from without, and of warm air into the room. The application of the apparatus described for fire places, stoves, and fire frames, for the purpose of warming rooms, and its general construction."

Whilst there is nothing new in this principle, the form pointed out for carrying it into effect would be one of the least efficient; the "general construction" is so general, and so extensively employed, that it is a little remarkable it should be claimed as new.

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74. For a *Furnace for generating steam*, on board of steamboats, and for other purposes; Eliphalet Nott, Schenectady, New York, March 19.

The improvement consists in giving a coating of silicious matter to the insides of furnaces for burning anthracite, so as to prevent that fusion which takes place when the lining is argillaceous, and also in covering the grate bars, or bottom of the furnace, with fragments of such stones as are suitable for the purpose, to protect the bars from the action of the fire. Each of these applications is claimed for the use of furnaces for steamboats. There is no adequate information given respecting the first application; we are merely told that the coating is to be performed "with some other material, (as *silex*) that will not flux by the mere action of the fuel in use; the same to be put on in the form of grout, as similar coatings are put on to melting furnaces, to prevent the action of the contents on the crust thereof." Now *silex* cannot be so put on, it not having the slightest adhesive property; and if mixed with clay, the two make a fusible compound. Nothing, we apprehend, is secured by this part of the patent, as there is not any thing practically explained.

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75. For an improvement in combined *Pen and pencil cases*; Henry Withers, an alien, who has resided two years in the United States; city of New York, March 19.

For this pen and pencil case, the two instruments are to be used at the same end, either of them being protruded at pleasure. The pencil holder, with its ordinary adjustments, slides through the tubular pen holder,

and the claim is made to "a pencil holder of any known or convenient structure, made so as to pass through, or by the pen holder, in his said combination."

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76. For a *Forge anvil block*; Samuel Van Tiers, M'Connelsburg Bedford county, Pennsylvania, March 19.

"The crib, sills, cellar or spring planks, and bed timbers, are made and arranged in the usual manner. Instead of the usual mode of having a wooden block upon which the anvil is placed, secured by the braces, props and wedges, my improvement consists in casting the anvil block of cast-iron, in a pyramidal figure, with a cavity to receive the anvil; it has flanches through which are apertures to admit strong screw bolts, by which to secure the anvil block to the bed timbers and spring boards. The bolts are passed through apertures in the spring boards, bed timbers, and the flanch of the anvil block, and secured by rivets resting upon the upper surface of the flanch, the other end of each bolt having a broad head bearing against the under sides of the spring boards."

"What I claim as my invention, and for which I ask a patent, is the cast-iron anvil block, and mode of securing the same, as before described."

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77. For a mode of *Conveying rafts, boats, &c., over dams and shoals*; Stephen Underwood, Bath, Grafton county, New Hampshire, March 19.

Two inclined, plane rail-ways are to be erected, one on each side of the dam, or other obstruction, over which a boat, &c., is to be carried; these are to extend into the stream, so that the load can be floated on to a car, constructed to run upon the planes. The planes are to terminate, at their upper ends, at the distance of from thirty to sixty feet from each other, or equal to that of the car upon which the boat or raft is to be carried. This space is occupied by a vibrating rail-way or bridge, which tilts on a centre, and will form a continuous plane with either of the sections accordingly as it is tilted towards the one or the other. A windlass, turned by water, or other power, receives a rope, or chain, by which the car can be raised, or lowered, upon the planes. When a load is to ascend, the bridge is tilted towards the plane up which it is to be drawn, and it is hauled upon it; the bridge is then tilted towards the descending plane, and the load is lowered into the water.

There is a contrivance on the car, by an arrangement of eccentric rollers, by which the level of the load can be changed, so that it shall stand horizontally in ascending and descending.

The claim is confined exclusively "to that part of the apparatus employed, which is denominated the *vibrating rail-way*, which is intended to receive the load at the summit of the inclined plane, and to be adapted by its vibrating motion to the plane of either, for the purpose, and in the manner set forth."

This plan has been carried into successful operation; large rafts of timber being conveyed, by its means, down rivers where the passage was previously attended with extreme difficulty, and where it could not, sometimes, be effected.

78. For an improvement in the process of *Tanning hides and skins*; Laban Emery, city of New York, March 19.

The patentee directs the hides, or skins, to be prepared for tanning in the usual manner, and adds, that "my improvement or invention then consists in the application to the bark liquor, of nitre, or alum, or epsom, or Rochelle, salts, or other neutral salts, either separately, or together, mixed in with the liquor, in the proportion of about four pounds to four dozen skins, more or less; and also bearing some proportion to the strength of the liquor. Every time the bark liquor is renewed, a like quantity of such neutral salt may be added, or not, as may be thought proper, or as the process of tanning may be required to be hastened. Either of said articles may be used separately, or together, in the process of tanning morocco, as well as every other description of tanning."

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79. For *Preserving milk for use on voyages, &c.*; John Lewis Granger, city of New York, March 19.

Fresh milk is to be put into bottles, and these are to be closed, in the manner of corking, with some porous substance, which will allow air to pass through it; the bottles are then to be put into a vessel of cold water, and the whole gradually heated to the boiling point, after which the porous stopper is to be covered with wax.

The claim is "to the evolving of gas, and suffering it to escape from the milk, and immediately afterwards excluding the atmospheric air from comingling therewith, by the method substantially as described."

We apprehend that the theory above intimated, namely, that the gas contained in milk is the cause of its spontaneous decomposition, is not founded in fact; were this the case, an exhausted receiver would as effectually effect the object in view, as the boiling heat, and this process would not be "substantially as described." There is a chemical change produced in milk by boiling, by which its liability to further reaction is very much diminished, and which would not be produced by the mere expulsion of gas. This theoretical point, we are aware, has nothing to do with the validity of the claim, although we have thought proper to give it a passing notice; we have also something to say about the novelty of the process. In the celebrated report published by the French Government in 1810, on Mr. Appert's mode of preserving all kinds of animal and vegetable substances, milk is mentioned as having been preserved by boiling and corking closely; it was concentrated in the boiling by allowing a portion of its watery particles to evaporate; the process was, we think, substantially the same with the above, the principle of which was perfectly well known.

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80. For a *Cider Mill*; Christian Sheaffer, Lebanon, Lebanon county, Pennsylvania, March 19.

This cider mill is to grind the apples by means of revolving nuts or, toothed cylinders, of which there are three, mashing into each other. All the novelty appears to be in the manner of building the mill. We are told that "the machine consists of two pair of stairs, a frame, an apple mill made of three cog wheels; cage or receiver, a press beam, two main screws, one assistant screw; two weight boxes, &c. &c." After describing the two pair of stairs, and the other component parts of the machine, it is said, "I claim as my invention the whole of the machinery, excepting what I have named the cage or receiver; the bed or box belonging to the cage or receiver, and

the manner of mixing the straw with the ground apples, or rather the *smashed* apples." This claim to the whole machinery, cannot be understood to mean the machinery as a whole, but as applying to its component parts individually; scarcely one individual of which could bear the burden thus put upon it, without being *smashed*.

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81. For a *Cooking stove grate*, and its appendages; Orrin Wilson, Concord, Middlesex county, Massachusetts, March 23.

The grate to contain the coal, or wood, is made with bars, and, in general, like the ordinary grate of an open fire place; but it is so affixed to a cooking stove, with ovens, or other desired appendages, as that it may be raised vertically, so as to communicate its heat more directly to the cooking department, or lowered so as to form an open stove. Above the grate, a windlass crosses, near the front of the stove, and four chains attached to this windlass, and to the four corners of the grate, serve to raise and lower the latter, as may be desired.

The claim is to "the movable grate, or pan, whether operated with chains and pulleys, rack and pinion, or other mechanical powers; the peculiar adaptation, arrangement, and combination of the several parts of the stove, fire frame, or fire place, to the said movable grate, for the uses and purposes herein described and set forth."

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82. For a *Stove*, denominated the Sibelline Stove; Wm. M. Carmichael, Hempstead, Queens county, New York, March 23.

A cylindrical stove, lined with fire clay, is made in the usual manner. The stove is to be surrounded by a second cylinder, leaving an air chamber between the two, with apertures below to admit cold, and others above to discharge warm, air. The whole stove is to stand upon a drum, or pedestal, of a diameter considerably larger than the stove itself, and is to be surmounted by another drum, or hollow dome, elevated a few inches above its top; a smoke pipe from the centre of the top of the stove, conducts the smoke into the drum. Four, or more, hollow columns, connect the two drums, surrounding, but detached from, the body of the stove; these columns form flues between the two drums, and from one of them a smoke pipe leads into a chimney, there being a damper in the column, above the smoke pipe. When this damper is open, the smoke and heated air pass directly through the upper part of the column, and into the exit pipe. When the damper is closed, the draught has then to pass down the three open columns into the lower drum, and up the fourth to the smoke pipe.

"The arrangement and adaptation of the several parts of the stove, producing the one before described," constitute the whole claim, which is about tantamount to not claiming any thing. The resemblance between this and the stove patented by Mr. Attwater, at p. 54, vol. xvii. is not very remote; and this latter, as is there described, we view as but a modification of Spoor's stove.

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83. For a *machine for manufacturing shoe pegs*; Reuben H. Thompson, Rochester, New York, March 23.

"The principal points upon which the inventor depends, is the *cutting* of pegs, instead of *splitting*, and the making them from a long cylinder of

wood, in a continuous course to the centre, and completing the peg from a solid block, wholly by machine power."

We cannot describe this machine without drawings of its parts. It is clearly enough described and represented, but the foregoing claim refers merely to the thing done, and not at all to the means by which it is effected; it has no bearing, in fact, upon the machine that is the subject of the patent, and which is, certainly, sufficiently original to have been directly claimed.

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84. For a *Cot Bedstead and Camp Stool*; Samuel Clark, city of New York, March 23.

The pin which connects the cross legs of this cot bedstead, or stool, is a toothed pinion, the teeth of which take into racks formed in a slot, or mortise, in either leg, and acting in such way as to stretch the sacking, by the weight placed upon it. A stretcher also extends across from one leg to the other, and the head board is so connected to the side pieces, as to allow them to recede unobstructed. The claim is to "the application of the stretching bar, and the movable rack and pinion joint, to the cot bedstead, and articles of a similar construction." The device is simple, but ingenious, and appears likely to answer a good purpose.

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85. For a machine for *Working off the ends of casks, and smoothing them*; Sumner King, Suffield, Hartford county, Connecticut, March 23.

A vertical, revolving shaft is to carry a grapple, or a kind of spring chuck, which is to receive and hold the cask that is to be worked off by a leveller, a stock howell, a croes, and a plane. The claim is to "the revolving grapple tub, that secures the cask."

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86. For an improvement in the art of *Dissolving Caoutchouc, or India Rubber*; Patrick Mackie, city of New York, March 23.

"What I claim as new, and of my invention, is the use of oil of tar, or spirits of tar alone, and also the use of oil and spirits of tar mixed with the prepared sulphate of zinc, as a solvent for dissolving india rubber, for the purposes aforesaid."

We could turn to patents for the use of the same liquid, in the employment

upon which the clothes are to be washed by a frame of rollers passing over them, constitute the machine; and "the before described machine for washing clothes," forms the claim.

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88. For a *Cannon vent*; John W. Cochran, Lowell, Massachusetts, March 23.

The thing here proposed is to place the vent of a cannon, by which the

the manner of mixing the straw with the ground apples, or rather the *smashed* apples." This claim to the whole machinery, cannot be understood to mean the machinery as a whole, but as applying to its component parts individually; scarcely one individual of which could bear the burden thus put upon it, without being *smashed*.

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The claim is to "the movable grate, or pan, whether operated with chains and pulleys, rack and pinion, or other mechanical powers; the peculiar adaptation, arrangement, and combination of the several parts of the stove, fire frame, or fire place, to the said movable grate, for the uses and purposes herein described and set forth."

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83. For a *machine for manufacturing shoe pegs*; Reuben H. Thompson, Rochester, New York, March 23.

"The principal points upon which the inventor depends, is the *cutting* of pegs, instead of *splitting*, and the making them from a long cylinder of



powder is ignited, considerably forward of its usual position, so that the fire may be communicated near the centre of the charge.

"In the position of vents now actually adopted, the charge is ignited at the bottom, and much of the powder is often thrown out of a cannon without being fired at all. This applicant contemplates the application of the principle of his improvement by placing the vent as far forward of the bottom of the breech, as the outer part of the powder may extend, and to put two or more vents in similar positions."

The idea of placing the vent as proposed, is without novelty, and has been frequently discussed by engineers. The following extract from Lallemand's Artillery, N. York. 1820, p. 18, is given in proof. "It is agreed upon all sides, that the vent of a piece of artillery would be most advantageously placed if it communicated the fire to the centre of the charge; for, in this case, the inflammation of the powder, which is not instantaneous but successive, takes place soonest. However, it is usually made to enter the bottom of the charge, to avoid too violent a recoil, that would derange the fire, and injure the gun carriages; particularly those of larger caliber."

89. For a *many chambered cannon*; John W. Cochran, Lowell, Massachusetts. First patented October 22d, 1834. Surrendered and re-issued upon an amended specification, March 23.

We noticed this invention at p. 326, vol. xv., and expressed an opinion that the use of a gun constructed like that described, would be attended with extreme danger. Since that period, however, the thing has been tried to some extent, both in this country, and at Constantinople, and as it appears, from all the information which we have gleaned upon the subject, without the realization of any of those difficulties which we apprehended. We are well convinced, in fact, upon more mature reflection, that some of the objections to it which we then deemed the most formidable, were not well founded; but we have not time, nor is it necessary, to discuss this subject here; it would afford us sincere pleasure, had we more frequent occasion to withdraw our objections to patented inventions.

The claim now made appears to us unnecessarily verbose; it amounts, however, simply, to the combination of a cylinder with a section of a cannon, the cylinder perforated on its periphery to receive the charges, and made to revolve by suitable devices, so as to effect the proposed object substantially in the manner described.

90. For a machine for *mortising and tenoning*; Erastus M. Shaw, Wilbraham, Hampden county, Massachusetts, March 23.

This machine differs in its general construction from most of the mortising machines which we have previously noticed, and by more labour than we can bestow upon it, we think that we might find out the manner of constructing it; but the drawing is very indifferently executed, and to decypher it is a task we shall not undertake. The claim is to "the arrangement and adaptation of the several parts of the machine, producing the one here described for mortising and tenoning timber; particularly the manner of operating the machine, in causing the carriage to move to the right and left, whilst the slide, with the cutter, moves horizontally backward and forward, at right angles to the carriage."

91. For *Condensing cotton roping, or slubbing*; William Fowler, Fishkill, New York, March 23.

"The principle of this improvement consists in the compressing of the sliver by means of a revolving groove, into which it is pressed by a revolving periphery pressing into and revolving with said groove, the said revolving groove and periphery constructed substantially, as aforesaid, and combined with a spool constructed and moving so as to take up this sliver when thus condensed, or compressed into roping spirally, as described."

To the idea of this invention given in the foregoing summary; we add that it consists of revolving wheels of about seven inches in diameter, and about three-eighths wide, having a groove, on its periphery, about one-tenth of an inch wide, and the same depth; four small, condensing wheels, each about one inch and a half in diameter, have tongues or fillets, which run in the grooves, and condense the roping, thereby producing the necessary firmness without the twist and counter twist, usually given by the condensing apparatus.

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92. For a *Straw Cutter*; James Hyde, Darien, Genessee county, New York, March 23.

There not being any claim made to any part of this apparatus, we know not what the patentee considers as new about it, and therefore pass it by.

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93. For a *Thrashing machine*; Hugh and Israel W. Edgar, Wayne county, Ohio, March 23.

This is a cylinder and concave machine, set with spikes, much in the usual way; the patentees claim the form in which they construct the frame, and the manner in which they fasten the spikes by screw nuts, rendering the whole strong and durable.

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94. For a *Rotary Steam Engine*; David Ulam, Greensburg, Westmoreland county, Pennsylvania, March 23.

A hollow drum, furnished with an opening to admit, and another for the discharge of, steam, is to have a wheel or drum, revolving in it, of such size as to leave a steam chamber between them. A projecting piece on the inner drum fills this cavity, and is made to recede, by suitable means, when it must pass the stops against which the steam is to react. The whole thing is nothing but an oft-told story, without a single new incident to redeem its monotony; but old as it is, and worthiness as it will prove to be, the patentee says, "what I claim as my invention, and which I desire to secure by letters patent, consists in the before described rotary steam engine."

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95. For a *Stone Auger, for boring rocks*; Andrew Turney, Reading, Fairfield county, Connecticut, March 30.

The main point upon which the claim under this patent rests, is the forming of the point of a stone drill, with a sort of knuckle joint, so that when inserted into a hole which has been drilled cylindrically by a common drill, the joint will bend on one side, and enlarge the hole at the bottom, that a larger charge of powder may be introduced, and its force increased. There is also a claim to the working of the auger with a spring, and to the kind of scraper used to remove the drillings. We doubt altogether the utility of the invention, as the apparatus is constructed, but cannot form a fair judgment from the evidence before us.

96. For an improvement in *Bee Hives*; Sturgess M. Judd, Danbury, Fairfield county, Connecticut, March 30.

The hive said to be improved, is that patented by Levi H. Parish, on the 5th of August, 1834. The claim made "in the suspension of said boxes, and in their movement, and in their movement in grooves, by which the bees are prevented from escaping during the removal of the boxes, as combined in the manner specified; and also the knives for separating the combs between the boxes and the slats." The peculiarities of these parts we leave to be examined by those interested in them.

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97. For an improvement in a *Suction and Forcing Pump, for fire engines*; John F. Rogers, Waterford, Saratoga county, New York, March 30.

A patent was obtained by the same gentleman, on the 27th of February, 1833, for a pump upon the same general construction with that which forms the subject of the present patent. We gave a pretty full description of the former, in vol. xii. p. 103. The claim under the present patent, will, with the aid of the reference just made, afford a tolerable idea of the nature and object of the proposed improvement, which, it will be seen, is to remove one of the objections made by us to the former construction.

"What I claim are the openings through the shaft by which the water is passed through the pump more direct than can be done in any other way, thereby removing the obstruction of the water caused by changing its direction."

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98. For an improvement in the *Power Loom*; Francis C. Lewis, Grafton, Worcester county, Massachusetts, March 30.

The claim under this patent refers to the drawings, and without these, therefore, could not be understood. The following quotation will furnish the object of the improvement, but not the means by which it is attained.

"The great practical advantage of my improvement is, that the web is driven up by the reed, while the cloth roller is stationary, and there is no power operating upon it, so that the thread of the web, and the cloth, receive the full blow of the latter; whereas, by the looms formerly in use, the cloth recedes, and is taken up as the latter strikes."

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99. For a *Horse Mill for grinding grain and scouring seeds*; John Harman, Jr., Brownsburg, Bucks county, Pennsylvania, March 30.

The grinding machine consists of two grooved, iron, cylinders, of different sizes, and running with different velocities; one of them having a narrow, fluted, iron concave to aid in the grinding. A horse power, by which the mill is to be driven, is also described, but there is not any representation of it in the drawing; both machines, however, are claimed; the claim being to "the combination and arrangement of the several parts of the horse power in connexion with the grinding machine, as set forth."

However good the inventions might be, the foregoing claims would invalidate them. The whole grinding machine is claimed, yet it possesses but little novelty; the horse power is claimed, yet there is no representation of it, as required by law. And what would of itself be fatal, two distinct machines are included in one patent.

100. For applying *Rivets to harness and gears*; William Dukeheart, city of Baltimore, March 30.

The claim made is the using rivets of metal, in the making of harness, instead of sewing, or stitching, as formerly practised.

101. For a *Tide Water Wheel*; Carey S. Mercer, Franklin, Baltimore county, Maryland, March 30.

A horizontal wheel is to be placed in a case, or drum, having flooms at opposite sides thereof, to direct the water upon the buckets, either on the ebb or flow of the tide; guide pieces, or wings, are fixed within the flooms to direct the water upon the buckets; and the claim made is to "the curved guider as described." The contrivance is not worth many words, and we could not talk it into utility.

102. For an improvement in the mode of *Spinning Wool*; John Wethered, Baltimore county, Maryland, March 30.

"What I claim as new in the machine herein described, and for which I ask an exclusive privilege, is the combination of a tube and other means, of giving a rotary motion to the sliver, with two or more sets of rollers of different speeding, a tube between each set, whereby a twist is given to the sliver, roll, roping, or slubbing, while it is passing from one set of rollers to the other, so enabling it to bear the elongation produced by the different speeding of the sets of rollers, in order to make it of the proper size for spinning: and I should consider any contrivance by which the strength of the sliver was increased by twisting between the sets of rollers, as an encroachment upon my invention."

The foregoing will suffice to inform those used to spinning machinery, of the nature of this invention; the object of which differs, as the patentee observes, from that of the revolving tube previously in use for condensing the sliver as it leaves the carding machine, to fit it for winding on the spools. The invention appears to be well adapted to the accomplishment of the end proposed.

103. For an improvement in the *Cotton Planter*; Michael Beam, Buffalo, Lincoln county, North Carolina, March 30.

This patent is obtained for an improvement on a machine patented by the same person, Feb. 13th, 1835. The present contrivance consists, in part, of a barrel shaped reservoir, in which the seeds to be planted are put, and which revolves, as the frame upon which it is supported is drawn forward; it has adjustable openings, for letting out the seed, an apparatus for opening the furrow, and a harrow for harrowing the seed in. The points intended to be claimed consist of the peculiarities of form, structure, and arrangement, which are not very clearly described, and could not be understood without drawings.

104. For a *Double Reflecting Lamp*; John C. Fletcher, Springfield township, Clark county, Ohio, March 30.

The lamp here described is of the hanging kind, the reservoir for the oil being formed like that of the astral lamps, so that the light can pass downwards without obstruction. There are to be reflectors above the light, polygonally formed, and sloping from the glass chimney upwards; the inside of the reservoir, also, is to be lined with similar reflectors, and around its

lower edges there is a trough for catching the drippings of oil. We are of opinion that these latter reflectors will produce but little advantage.

105. For a *Hat Block*; Wm. W. and S. H. Jameson, Wheeling, Ohio county, Virginia, March 30.

This block is to be in six pieces, four outside pieces, two of them formed by cutting opposite segments from top to bottom, off the opposite sides of the block, and the other two by cutting the middle segment across, so as to leave a square centre piece, somewhat pyramidal in form. There are to be tongues formed up each side of the centre piece, and corresponding grooves in the side pieces, extending to within an inch of the top, serving to prevent all lateral slipping. In steaming, the centre piece is to be plain. There is to be a Boss block, of the usual construction; and to the bottom of this a *circular pedestal* is to be attached, by a bolt passing through the centre of each. The claim is to "the before described block for finishing hats, especially the tongues and grooves, and the circular pedestal which permits the block to revolve freely whilst finishing hats."

106. For forming *Joints for Bedsteads and other wood work*; Solomon C. Batchelor, and Nelson S. Thomas, Watertown, Jefferson county, New York, March 30.

The patentees claim, "being able to frame, by means of keys, right angled works, where the rails, or timbers are on the same level," and we have looked into the thing, with more than common care, to find something about it "not previously known;" but we have not been able to discover any thing which is not well known to every workman who has made mortises and tenons. The rails are to be tenoned into the posts in the usual way; one end of the tenon to be cut dove-tailing, and the mortise sloped to suit it; a wedge, or key, is to be inserted at the other end, and the work is done. In this simple and well known affair, it would be difficult to assign to each of the two patentees, the amount of his inventive contribution.

107. For a *Vertical Wool Spinner*; William Sykes and George M. Conratt, Fredericktown, Frederick county, Maryland. First patented March 10th, 1834. Surrendered, and re-issued upon an amended specification, March 30.

The object in view in this patent, is the same with that of Mr. Wethered, No. 102, but the means of attaining it are different. The following is the claim, "What we claim as our invention, is the constructing of drawing rollers for spinning machinery, in such a manner as that they shall embrace the thread between them during a part of their revolution only; allowing it to twist freely, unobstructed by them during the remaining period; by which means we are enabled to carry the twist directly from the flyers up past the drawing rollers, without employing any intermediate machinery; using in conjunction with such drawing rollers, either live or dead spindles, and such other parts as are ordinarily employed in spinning machines, and to which we make no claim."

The proposed mode of relieving the thread from the action of the drawing rollers, is by cutting off a portion from one side of them.

108. For an improved *Franklin, or Open Stove*; John H. B. Swansey, Lynn, Essex county, Massachusetts, March 30.

"The improvement made by me is the addition of two more flues, or drafts,

beside the common ones in the Franklin stove. One of said additional flues is to be made a little above the middle of the fire back, and to extend horizontally the whole length of the back, and is to be provided with a common damper, to open and close it. The other additional flue is to be placed along the front plate of the stove."

The drawing does not exhibit the thing very clearly; it does not, however, so far as we can judge, appear to be an affair of much importance.

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109. For *Compressing Hay, &c., and elevating heavy bodies*; Adrastus R. Chamberlin, and Artemas Cleflin, Richmond, Lincoln county, Maine, March 30.

A pinion and wheel are to turn a shaft, round which a chain is to wind, which chain passes over a pulley at the end of a piston rod, that is to carry the follower for pressing. The other end of the chain is to be fastened to some fixed body. Instead of passing over the pulley, on a follower, the chain may be attached to a stump which it is desired to draw from the ground.

The claim is to "the application of the pulley as used by us, for a single or double press; and the application of our machine to the raising of stumps or other heavy burdens." There are so many better machines, for effecting the same purposes, that this will stand but little chance of going into operation; or if it has been used, we apprehend that it will soon cease to be so.

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110. For an improvement in *Wind Mills*; Job Wilbur, Fall River, Bristol county, Massachusetts, March 30.

This is to be a horizontal wind mill, to contain the vanes, or wings, of which, a round building, thirty feet high, and twenty in diameter, is to be erected; the upper part of this building, is made to revolve on the lower, in order to change the situation of two windows, or openings, made for the admission and discharge of the wind. Six vanes, placed on a vertical shaft, in the centre of the building, are to receive the action of the wind; these vanes are to be angled to hold the wind the more effectually.

There is no claim made, a point, in the present case, of no great importance, the structure being very much like others which have been tried, and abandoned.

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111. For a *machine for manufacturing Axes*; Elisha K. Root, Canton, Hartford county, Connecticut, March 30.

We shall hereafter notice this machine, in conjunction with some others in use, at the axe manufactory in Collinsville, Connecticut, to which establishment we, a short time since, made a visit.

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112. For a *Forcing Pump*; Nathan Chapin, Penn-Yan, Yates county, New York, March 30.

We see no reason to attempt a description of this double barreled forcing pump, as we cannot discover any valuable point in it beyond such as are in ordinary use.

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113. For a *machine for ploughing and thinning cotton*; Harvey W. Pitts, Wilsonville, Shelby county, Alabama, March 31.

The claim made is to "the machine as described," a claim which it will hardly bear, as parts of it are very similar to machines which have been

used for like purposes; yet we believe there is sufficient novelty in the contrivance to enable it to sustain the character of a new machine. We shall not take time to describe it, as it would be no easy task to render it intelligible without a drawing.

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114. For a *Corn Sheller*; Albert W. Gray, Middletown, Rutland county, Vermont, March 31.

This machine is to operate upon the ears by means of a revolving, flat wheel of wood, set with points, and standing vertically; the ears are to be held up against it by means of a spring conductor. The general arrangements are very similar to those in other revolving, disk shelling machines, and the particular points and combinations which are made the subject of a claim, appear to be unimportant, not, we apprehend, rendering it either better or worse than others previously in use, and now public property.

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115. For *Wagon and Carriage Springs*; Newell Hungerford, Ithaca, Tompkins county, New York, March 31.

Spiral springs which are wound round an iron bar crossing the carriage, and attached to the bar at their inner ends, are, at their outer ends connected to the bottom of the body of the carriage, or wagon. The round bar, above named, is supported at the two ends by a bowed piece of iron, bolted to the axle through its middle. The specification ends abruptly, without pointing to any novelty, or making any claim. A single coil of spiral spring will not fulfil the intention of a carriage spring; it has been tried in various ways.

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116. For an *Awl Shaft*; David M. Smith, Gilsum, Cheshire county, New Hampshire, March 31.

The wooden part of this haft is in two pieces, the lower piece containing the socket, and fitting, and revolving, in the upper one by means of a round pin; the wood part of the socket is bored tapering, and has in it a split, metallic socket, into which the shank of the awl is inserted, when, by turning the two parts of the haft upon each other, a nut draws the split socket inwards, and holds the awl.

The claim is to the "constructing an awl haft, so as to move the split socket in and out, into which the shank of an awl blade is inserted, and by which it is held firmly, as above described."

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117. For an instrument for *Cutting the Soles of Boots and Shoes*; Jonathan Hill, Billerica, Middlesex county, Massachusetts, March 31.

A knife is to be made in the form of the sole to be cut, and this is to be pressed on to the leather by a press, or in any other convenient way. Two iron bars are described, which are to lie along the back, or upper side of the knife, from heel to point, but these are not an essential part of the contrivance. The affair is not new, such knives having been made, and patented, both for cutting uppers and soles. The claim is to "the construction of the knife, being entirely in one piece; and the application of the same to the purpose of cutting soles, by means of a lever, or lever press.

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118. For *Reflecting Ovens*; Cicero Van Allen, Penn Yan, Yates county, New York, March 31.

In the claim appended to the specification of this reflecting oven, we are

told about two new principles in it, yet we are at a loss to discover one; it is so much like some other tin kitchens, for baking and roasting before the fire, and our eye so little like that of the inventor, that we cannot see the new parts to which he believes that he directly points. The sides, back, and bottom appear to be rectangular, and the top to slope regularly back; there is a spit for fowls, hooks for birds, bars on which to place pans, a dripping pan to catch the gravy, and a peep hole through which to observe how matters go on, and these constitute the "single reflecting oven."

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119. For a *Self moving and accumulative engine*; John James Giraud, city of Baltimore, March 31.

How many self-moving and accumulative engines have the same parentage with that before us, we cannot recollect, and do not think it worth while to examine, in the patent office, the register of their births; as to their deaths, no register exists, they having all been still born; we know, however, that the family would have been a large one had they received and preserved the living principle. We can tell little about the affair before us, but its author informs us that "the fly wheels run on friction wheels, bearing on the main shaft, and constitute the generating, regulating and maintaining powers of the engine." The power thus generated, regulated, and maintained, is to be applied to "general navigation and other purposes." Happily for the community, however, neither general navigation or other purposes which demand motive power, will consent to wait the generating, regulating, or maintaining power of Mr. G.'s accumulative engine, as otherwise they would never be generated, regulated, or maintained.

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120. For a *Churn*; Thomas Nicholson, New Market, Shenandoah county, Virginia, March 31.

A churn, with a tub in the ordinary form, has a dasher shaft, which is to revolve alternately in reversed directions; for this purpose there are two beveled pinions upon the shaft above the lid; and a beveled segment wheel is to engage first with one, and then with the other of these pinions; such a contrivance is bad in principle, as all machinists know; segment wheels being generally poor things, and, as here applied, altogether worthless.

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121. For *Pronged Hoes*; Benjamin F. Boyden, Boston, Massachusetts, March 31.

These hoes are to be of cast-iron, rendered malleable in the usual way. They are to have raised ribs along the prongs, &c. to strengthen them, and to be tinned over their whole surface. The claim is to "the application of cast-iron in the manufacture of agricultural pronged hoes, and covering the same with tin;" but where is the invention or discovery?

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122. For an improved *Winnowing machine*; Jonathan Bean, Montville, Waldo county, Maine, March 31.

We are told that "the advantages this machine claims above others now in use, consist in durability, portableness, and expedition in cleaning all kinds of grain;" but although the machine claims this, the patentee does not claim the machine; and although he has given a voluminous account of admeasurement, and many outlines of separate parts of it, its construction

is very imperfectly represented, and its peculiarities, if any it have, are unnoticed; the patent, in fact, is a patent for nothing.

123. For *Hose to convey water*; Samuel Hunt, city of Baltimore, March 31.

"What I claim is the application of hose, whether constructed in the manner set forth, or otherwise; not intending to confine myself to particular dimensions or materials in its construction, for the purpose of carrying good and wholesome water, for the use of cities, towns, and villages, &c. across rivers, ponds, bays, creeks, or elsewhere."

There are two doubtful things in this patent; first, it is much to be doubted whether a man can be prevented from conveying water in a hose, through a creek, &c.; but a more important point is the doubtful utility of the thing, for the purpose intended. A flexible hose, large enough to convey a supply of water for the consumption of towns, it will be difficult to make, more difficult to fix, and most difficult to keep in order.

124. For a *Blacksmith's Tew Iron*; John Shugert, Elizabeth, Alleghany county, Pennsylvania, March 31.

"The improvement claimed by the petitioner, is the angles in the pipes and plates, by which it is made entirely fire proof, or indestructible."

How this desirable end is to be attained by the construction of the instrument described, we do not perceive. An iron back is to be made to the forge; the pipe which leads to the opening for the blast, is to be ten, or twelve inches in length; the hole through it about two inches in diameter, at the back end where the bellows enter, and gradually diminishing to one inch, next the fire. At about the middle, the pipe is bent down at an angle of from twenty to forty degrees towards the fire. Instead of the usual collar next the fire, there is to be a metal plate ten inches long, and nine broad, "about one inch from the centre of which there is to be an angle of about ninety degrees, the broad part of this angled plate is to have a rise on the face of it at the centre, one inch high, and ten inches along the plate; the thickness of the said plate to be about three-fourths of an inch."

The foregoing description does not appear to us very clear, but it may be more fortunate with our readers.

125. For *Blowing air into a millstone eye*; Austin Taylor, Littleton, Grafton county, New Hampshire, March 31.

"What the applicant claims as his invention, is the introducing a current of fresh air into the eye of a mill-stone, by any wind instrument or machine." Wind has already been blown into the eye of a mill-stone, to keep it cool, and has been made the subject of at least one patent.

126. For *Spark Catchers, for locomotive steam engines*; William Schultz, county of Philadelphia, Pennsylvania, March 31.

There is to be a swell in the smoke pipe, which will give to it the form of two funnels joined together at their rims; and across this wide junction there is to be wire gauze stretched, the enlargement being intended to prevent any obstruction in the draught. The pipe for waste steam is to perforate the sheet of wire gauze, which is secured to it by a flanch. Flues, which may be opened when the engine is at rest, are to pass on the outside

of the conical enlargements, allowing a free draught; these are to be closed by valves, when the engine is in motion.

CLAIM. "What I claim is the whole arrangement, as hereinbefore described, without any connection with any other machine heretofore constructed for the same purposes."

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127. For a *Horse Power*; Richard Skinner, Williamson, Wayne county, New York, March 31.

A main wheel, turned by levers, or sweeps, is to run upon a hub, and axletree, instead of being fastened to a shaft. Nothing more.

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128. For a *Cooking Stove*; Benjamin H. Pearson, Warner, Merrimack county, New Hampshire, March 31.

This stove has an open fire place, in the form of a Franklin; to which is attached an oven, and other contrivances for cooking. The claim is to "heating the oven on five parts; its particular situation to give a draft under the oven, with an open fire-place; the damper; the turning a crank with two half oval wheels to raise or lower the grate in the fire-place."

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129. For a *Hydrant*; David Horn, city of Baltimore, March 31.

There is nothing in the principle, and but little in the arrangement, of this hydrant, different from others in common use. The pipe through which the water enters, under ground, has a socket in it that receives a vertical shaft, up which it is to flow to the point of delivery; the lower end of the shaft fits into, and turns in the socket, as a key in a cock, allowing the water to pass into it when in the proper direction, and when turned round a quarter of a circle, the water in the shaft runs into the ground through a waste hole in the socket.

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130. For a mode of *Joining Rail-road plates*; A. Mizick M'Cain, Montgomery, Montgomery county, Alabama, March 31.

A lap is to be formed at the junction of rail-road plates, by which each plate shall be in part over and in part under, its fellow; and so that a spike driven through shall confine both. The manner in which this may be done will be more readily conceived than described; to save circumlocution, therefore, we leave the mode of effecting it to be devised by the ingenuity of the reader, or to be learnt by application at the patent office.

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131. For an improvement in *Rail-roads*; Nathan Read, Belfast, Waldo county, Maine, March 31.

The oft-proposed device of a rack on the middle of the rail road, and of a toothed wheel on the axle of the locomotive, is the subject of this patent. The rack is to be made with rounds like a ladder, and the teeth in the wheel are to be larger than usual; these constitute the only change proposed in the mode described.

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132. For an *Ointment for Cancers*; Elias Gilman, Licking county, Ohio, March 31.

This ointment has the merit of being a tolerably safe application, which is much more than can be usually said of ointments for the cure of cancer. It consists of finely pulverised sulphate of iron made into an ointment with mutton suet. It is to be spread upon linen, and renewed when necessary.

The cancer is to be washed with a decoction of spikenard and tanners' ooze, and a decoction of yellow oak bark, and sometimes with a solution of potash and water.

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133. For a *Gripe Chuck, for turners*; David Peeler, Boston, Massachusetts, March 31.

This gripe chuck, it appears, is principally intended to hold, and to turn in the lathe, certain tools used by boot and shoe makers, known by the name of heel keys, fore part irons, and fore part beads. These, it is said, can be manufactured at a much cheaper rate, by means of the gripe chuck, than by the common mode. The claim is to the particular kind of chuck described.

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*Specification of an improvement in the Art of Tanning, granted to Henry C. Locher, Lancaster, Lancaster county, Pennsylvania, administrator of Henry Locher, deceased, March 12th, 1836.*

To all to whom these presents shall come, be it known, that Henry Locher, late of the city of Baltimore, now deceased, in his life time, had invented a new and useful improvement in the art of tanning, called a Communicable Leach System in the art of Tanning, and that the following is a full and exact description thereof. A general communication with every vat intended to be used, is made by means of trunks, or tubes, placed on the outside, and about six inches from the top of the vat, and made level so that water may be sent with equal ease in any direction through them; a perpendicular trunk or tube, is placed in one corner of each vat, extending from the top, to within about four inches of the bottom; small tubes are branched off from the main, or horizontal trunk, or tube, and inserted into each of the perpendicular trunks, or tubes, and also into the opposite ends of the vats called handlers, and into the reservoir; other small tubes are made to connect the several perpendicular trunks, or tubes, with the adjoining vats, of those generally termed leaches, so that the liquor or juice of the bark may be transferred, or driven from one vat to another, in any direction. The perpendicular trunks, or tubes, may, to save room in the vats, be placed on the outside, with communication at the bottom.

This plan enables the tanner to multiply the liquors or juices, in the vats termed leaches, to any degree of strength, and at the same time to exchange strong for weak, without mixing scarcely any, and without labour more than drawing the plugs out of the tubes necessary to be opened, and turning the water from the hydrant, or pump, on one or more of the leaches, thus as many as you please will exchange, and the leaches successively recruit in strength. This is done on the philosophical principles of the lighter bodies rising to the top. As for example, to drive the strong liquor out of the vat, cause a light and steady stream of water to fall on the bark in the vat, or on a board laid on top of the liquor, and as soon as the liquor rises to the tube, in the perpendicular trunk, it escapes by that tube, and is let into any other vat that is opened to receive it, and its place is supplied by the water; if the reverse is wanted, let the liquor into the perpendicular trunk, it sinks to, and spreads over the bottom of the vat, and raises the water to the top, where it escapes by the small tube.

False bottoms are useful in this operation, as they prevent the trunks or tubes from being stopped, or clogged, and they receive the settlings.

What I claim as the invention of Henry Locher, deceased, and not previously known, is the trunks and tubes, and the manner of using them.

HENRY C. LOCHER.

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**Progress of Practical and Theoretical Mechanics and Chemistry.**

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*Earthen retort for generating gas for the purpose of illumination.* A patent for a composition for this purpose was secured to Thomas Spinney, of Cheltenham, gas engineer. The materials are—Stourbridge fire-clay, one hundred pounds; burnt Stourbridge fire-clay, twenty pounds; pipe clay, twenty pounds; sand, (which is recommended to be as free from lime as possible) twenty pounds.

The Stourbridge clay, both raw and burnt, are to be mixed together with the sand. The pipe, or potters' clay, must be well dried and broken into small pieces, and afterwards put into a copper, or furnace, containing as much boiling water as may be requisite to dissolve or reduce it to the consistence of thick cream, which is to be added to the other materials previously mixed; and as much more water is to be added as will make the whole mass of such a consistence as will admit of its being tempered in the manner generally practised by potters.

The materials thus combined, may be moulded into retorts of any required form; but the patentee says, I do not mean hereby to confine myself to any particular form or size of retort; they may be made in one or more pieces, as may be found most convenient. If made in one piece, after being dried, it must be brushed over with a glaze, or cement, composed of the following materials in the following proportions: of potters' lead ore, three pounds; sand, four pounds; sulphate of iron, one pound; pipe or potter's clay, one pound. These are to be reduced to fine powder, and mixed with as much water as will bring them to the consistence of paint, and then applied with a brush in the same manner as paint is used by painters. The retort must then be removed to the kiln, and what is technically termed smoked from twenty-four to thirty hours; and afterwards cooled or let down in the usual manner of cooling down earthenware. If the retort is made in more than one piece, the pieces should be formed to fit each other, and joined together with the above mentioned cement or glaze. The retort so formed is also to be brushed over with the said glaze or cement in the manner explained when the retort is made in one piece."

Newton's Journal.

*Patent invention for assisting the hearing.* Mr. Webster was led to a consideration of this subject, by a sensible diminution of hearing in himself. He adverts to the common practice of applying the hollow of the hand to the back of the ear; to the fact that eastern nations, particularly the ancient Egyptians, (as is evident in antique remains) had the ear more fully developed, larger and more projecting; that this is still the case with savages, who are remarkable for the acuteness of their hearing; that the modes of covering the head have probably produced a permanent compression and diminution of the shell of the ear; and finally, that the Arabs, and occasionally individuals among ourselves, have voluntary power over the muscles of the ear.

The instrument he has invented he terms an **OTAPHONE**.

"They are formed from a correct model of the back of the ear, and by fitting all the irregularities of that very uneven and elastic surface, gently

press forward the parts so as to produce a more perfect orbit, and fuller recipient and sound; and being self supported, they occasion no inconvenience to the wearer. By thus concentrating all the powers that nature has provided, a considerable addition to the ordinary force of sound is obtained; dissipating dulness of hearing, when not arising from internal injury, and enabling those in whom this sense is perfect, to preserve the same advantage at a much greater distance. They will, therefore, be found particularly useful in places of public worship, courts of laws, the Houses of Parliament, theatres, and wherever the ordinary powers are insufficient; and by bringing the focus of sound into a more direct line with the face; the expression of the speaker is better preserved than by the unassisted ear.

It is, however, on the advantages they permanently confer, when their use is discontinued, or very rarely resorted to, that the inventor places his greatest reliance for their general adoption. Though obtuseness of hearing arises from many causes, one of the most frequent is the insufficient quantity of sound the external ear collects. When this is the case, the membrane of the tympanum, or drum of the ear, and the internal organs which depend on the vibration for their active employment, become relaxed, and contract the same degree of feebleness as would attach to any other part deprived of its natural action; and this inertness, or stagnation of their powers, renders them unable to surmount those occasional injuries that blows, colds, fevers, &c. create; and thus, from the most common accidents, a permanent injury to the sense is induced, which a more active state of the parts would frequently remove.

The otaphones are based upon the principle, of proportioning their assistance within the limits apparently assigned by nature. The alteration they occasion when worn, is but a restoration of the ear to its original and most useful shape; and for all their subsequent advantages, they depend on that peculiar fabric before described, and which is so happily adapted to the purpose, that no other substance can supply its place. They will, therefore, be found equal to the perfect restoration of the hearing, if any increase of sound, however trifling, is perceptible on their first application, and generally the use for an hour each morning, for a short time, is sufficient; but if the impediment has been of long continuance, and no advantage on trial is experienced, their employment, without previous preparation, will not be recommended.

London Mec. Mag.

*Manufacture of Beet-root Sugar in Russia.* The manufacture of beet-root sugar in the Russian empire has of late become very extensive; there are already no less than twenty-five large establishments for this purpose in different parts. Thinking that the following account of one of the principal of these establishments, viz. Micharlofsky Sugar-works in the government of Tula, the property of Count Bobrinsky, may be interesting to the English public, I send it for insertion in your widely circulated Journal:

The quantity of beet worked in the year 1835 was 260,000 poods = to 85,357 cwt. 0 qr. 16 lbs.; the sugar produced from it, 15,600 poods = 5014 cwt. 1 qr. 4 lbs.

Price of a pood of beet,	-	-	-	15 copecks.
Expense in working do.	-	-	-	35 do.
				<hr/>
				50
				<hr/>

Produce of one pood of beet  $2\frac{3}{4}$  lbs. of raw sugar at 1 ro. 10 co. per lb.

The number of men employed 250.

The quantity of land required to produce the beet 350 deciatines—945 acres.

The beet is generally taken from the peasantry instead of the obrok or fine, they, as serfs, would have to pay their baron.

The proprietor of this manufactory is an accomplished and amiable nobleman; his experiment in this case has been highly successful.

One great evil is the impossibility hitherto experienced of keeping the roots any length of time, which makes it expedient they should be worked as soon as possible after they are taken from the ground.

I have been favoured with a specimen of raw and refined sugar from these works, of which I send you a small sample, and am only sorry the distance does not allow me to send a larger one.

The Russian lb. is equal to  $14\frac{1}{4}$  oz. English; a pood 40 lbs. Russia=36 lbs. English; a rouble=100 copecks; sterling value  $10\frac{1}{2}$ d.

Your constant reader,

J. K.

*Petersburg, June 25, 1836.*

[The samples sent are excellent; the raw sugar not quite so good as that from the cane, but the refined equal to the best products of our refineries.—  
ED. M. M.]

*Idem.*

*New mode of preparing Kerm's Mineral and the Golden Sulphur of Antimony.* By M. MUSCULUS. For the golden sulphur of antimony, I take—

Lime, slacked with a sufficient quantity of water,	6 parts.
Sub. carbonate of potash, or dry sub. carbonate of soda,	4
Finely pulverized sulphuret of antimony,	2
Flower of sulphur,	1
Sand, well washed and dried,	8

Mix them all well together, and put them in a funnel or other separating vessel, with a few small pebbles or coarse bits of glass underneath, and cover the mixture with a layer of sand. Pour on this by degrees, cold water, until the filtered liquid is no longer precipitated by hydrochloric acid.

The liquid thus obtained is to be sufficiently diluted with pure water and treated with hydrochloric acid. The precipitate, or golden sulphur of antimony, is to be carefully washed and dried in the common way. The product is about equal to the sulphuret of antimony employed.

To prepare Kerm's mineral proceed in the same manner, only leaving out the flower of sulphur. The liquid obtained is to be treated with a solution of bicarbonate of soda; or by passing through it a current of carbonic acid gas.

This method of preparing these two substances, by displacement, is new, and much more simple and economical, in time and expense, than the usual mode, and the products are as fine and abundant. The proportions may not perhaps be so rigorously exact as further experience may dictate. It is possible that a previous maceration may be useful.

*Note by M. Boullay.* We have repeated the process of M. Musculus, and find that the golden sulphuret of antimony, which it yields, is very beautiful—the kermes is heavy, and the colour not very good, but by substituting the dry carbonate of soda for potash, and adding to the filtered fluid an equal volume of pure water, deprived of air by heat, prior to the precipitation, we have obtained the kermes in great abundance, light, and of fine bright colour.

Thus the preparation of kermes, till now so embarrassing and capricious, will be extremely easy to practice, in small quantities as well as large, and the pharmaceuist will be no longer excusable in depending on commerce, now he can extract the kermes by simple lixiviation, in the cold, instead of long and reiterated ebullition.

Jour. de Pharm.

*Preservation of Cantharides.* The rapidity with which mites attack cantharides, and the fact that they devour the soft parts of the flies, which are the most active, render any mode of effectual preservation very useful.

An experience of ten years enables me to affirm, that the process of Appert will thoroughly preserve them. The bottles containing the dried and sifted flies, being thoroughly corked, and fastened with double pack thread, are to be placed upright in a kettle of water, which is to be heated to ebullition and kept boiling, for half an hour, the bottle remaining until the water gets cold. They may then be put away in any cool place. If the insects are pulverized on being first taken from the drying stove, again left in the stove for a few hours previous to their being bottled, and afterwards treated as above, they will be still more effectually preserved. The eggs of the mites which adhere to the cantharides, though they may escape the heat of the stove, are destroyed by the boiling temperature, in well closed bottles.

Idem.

*Preparation of Extracts.* The usual mode of obtaining vegetable extracts is by the aid of *heat*, but it is well known that the medicinal properties of compounds are often essentially altered by changes of temperature, and that the proximate principles of plants on which the virtue of extracts depends, may therefore be subverted at the high temperature at which they are sometimes obtained.

M. Guillard proposes to avoid the risk of such a deterioration, by pounding the fresh plant in a mortar, pressing out the juice in the cold, and evaporating it by a current of air from a smith's bellows. In this way he has perfectly succeeded in procuring the extract of *Aconitum Napellus*, after pounding, pressing and filtering, when the temperature of the laboratory did not exceed  $10^{\circ}$  to  $13^{\circ}$  cent.

A more perfect mode, perhaps, would be to evaporate by means of a vacuum, without heat, by which the agency of the atmospheric oxygen would be very much avoided, as well as that of increased temperature.

Idem.

*Improvement in the Manufacture of Charcoal.* It is well known that there is a very great loss of the carbonaceous portion of the wood in the usual careless way in which charcoal is made; and yet the greater density which the coal acquires by this process, than by that of close distillation, renders its quality very superior for the purpose of reducing ores. This is probably owing to the slower carbonisation which the wood undergoes, by which its molecules are dilated with less rapidity and force.

It has been ascertained by experiment, that when the interstices of the wood stacks for charcoal are filled with saw dust and the stack itself covered with it prior to the application of fire, the product of coal is from seven to nine per cent. greater than in the ordinary way. It requires rather more care in the beginning, to get the fire under way, and prevent its going out.

By covering, or mixing the charcoal with tar, before it is put into the

furnace with ore, so great a degree of activity is given to the fire, it may be worth the experiment to ascertain whether it would not be good economy to employ the tar of certain districts in this way.

Jour. Conn. Usuelles, Mai., 1836.

*Preservation of Leeches.* It has been found that a layer of charcoal in the bottom of the vessel of water in which leeches are kept, tends to their preservation. The writer left 25 leeches in a bottle for three months, expecting on his return to find them all dead, but, to his surprise, they were all alive. He afterwards obtained the best results by adopting this plan—changing the water once a week, a fortnight, or even a month, when inconvenient to do it oftener.

He also finds, that by placing the leeches, when full of blood, on ashes, in a dish, they will in a few minutes completely disgorge themselves, and when well washed in fresh water, will answer for subsequent operations. He has renewed this process more than twenty times, and has yet lost but four leeches.

After four or five days repose, they will perform their service as well as at first.

Idem.

*Pork establishment of Mexico.* There exists in Mexico a very fine race of hogs, which are regarded as an important article of commerce, and the care which is taken of these animals so far surpasses that which I have seen elsewhere, I think it may be very useful to our farmers, brewers, and distillers, to be made acquainted with the principal details.

The buildings of these establishments include a house for the manager and the workmen, a shop, a slaughter house, a place for singeing, rooms and vessels for the fat and lard, (articles which often supply, in Mexico, the place of butter) other rooms where black pudding is made and sold to the poor, and a soap manufactory, in which all the offals are used. The stables, which contain about 800 hogs, are behind these buildings. They consist of out-houses, well made, thirty feet deep, with overhanging roofs. The entrance is by a low vault, in front of which is an open space twenty-four feet wide, extending the whole length of the yard. In the centre of this is a stone aqueduct, through which flows clear water from a well or spring, the hogs being allowed to pass their snouts only into the stream, through openings in a wall, which prevents their soiling the beverage. It is the only liquid they are allowed to take. They are fed with Indian corn, slightly moistened, and spread upon the floor. The pens and the space on which the animals walk are kept in great cleanliness.

The hogs are in the immediate charge of a number of Indians, attached to the establishment, and who often give them a cold bath, for it is thought that cleanliness contributes to that prodigious increase of fat which constitutes their principal value. It is the business also of these care takers to keep them in good humour. Two persons are employed from morning to night in adjusting their quarrels, and in singing to induce them to sleep. These persons are chosen on account of the strength of their lungs and ability to charm the ears of their amiable associates, which is deemed an affair of no inconsiderable merit!

The proprietor of one of these establishments assured us that the expense of it amounted to 300,000 francs, and that the sales rose to 10,000 a week: the luxury of his equipage indicated, in fact, the possessor of a large fortune.

Idem—Juin, 1836.

*Process for determining the existence of Sulphurous Acid in Common Hydro Chloric Acid.* By M. GIRARDIN, *Professor at Rouen.* Put into a glass about half an ounce of the hydrochloric acid to be tried, and add to it 120 to 180 grains of the proto-chloride of tin, (common muriate of tin) very white and not altered by the air, stir it with a rod, and add to it two or three times as much distilled water, and agitate the mixture. If no sulphurous acid be present, nothing appears; the salt dissolves, and the fluid only becomes a little disturbed by the action of the air on the salt; but if the smallest portion of sulphurous acid be present, a cloud is immediately perceived, the acid becomes yellow, and when the distilled water is added, the odour of sulphuretted hydrogen is manifest, a brown appearance ensues, and a powder is deposited. These phenomena are so obvious, that there need not be a moment's hesitation with respect to the sulphurous acid.

Sometimes the brown colour does not appear till after some minutes have elapsed. The more sulphur, the deeper it is. The sulphuretted hydrogen is evident only when the water is added. The yellowish brown powder which subsides is a mixture of sulphuret and peroxide of tin.

This process will detect a hundredth part of sulphurous acid in the hydro chloric. The method is now practised in the workshops of Rouen.

*Annales de Chim. Mars. 1836.*

*A new process of Carbonisation, by the aid of the waste flame at the tops of high furnaces.* By M. VIRLET, *mining engineer.* This process has been practised more than a year by Fauveau-Deliars, forge master at Bièvres, near Grandpré (Ardennes) as well as at several high furnaces in the neighbourhood, with complete success. It seems to have resolved the problem, for a long time a matter of research,—to discover the means of economizing and turning to account, the great quantities of fuel which are entirely lost in the forests, by the common method of coal burning. It consists in allowing the heat of the coal kilns to go no farther than is necessary to drive off the water and the oxidating gases. It appears to me to be destined to produce a revolution in forges. A patent for fifteen years has been granted for this improvement, to Houzeau-Muiron, and Fauveau-Deliars.

The following statement is taken from the books of the High Furnace of Montblainville, of results before and after the adoption of the new process:—

Seven cords of wood, of fifty to fifty-two cubic feet, gave, by the old process, four kilolitres (thirty-five cubic feet) of charcoal, producing 800 kilogrammes of cast-iron,—about one ton. To this must be added the market toll, which, in that district, is one-sixth, which brings the actual consumption of charcoal to four and two-third kilolitres for 800 kilogrammes of iron.

Three and a half cords, of the same dimensions, give, by the new method, the same quantity of charcoal, or four kilolitres, producing the same quantity of iron, but less mixed, better, more tenacious, softer, and attended with less loss in blooming, whether by charcoal or pit coal.

There is no toll on the charcoal in the new process, for it is thrown into the furnace as soon as made, and while still warm. It is also proved that the furnace works more rapidly with the new charcoal, increasing the fabrication one-third; so that there is to be added to the advantage before

mentioned, a diminution in the general expenses of production, and a diminution of one-half in the quantity of wood consumed.\*

*Annales des Mines, 1836.*

**M. DE MILLY's Star Candle Manufactory, Paris.** The French appear to have effected a great improvement in candles, by separating the crystallizable portion of tallow, the stearine, from its other constituents, and rejecting the latter in the composition of their bougies. But stearine itself is a compound of stearic acid and glycerine, and it is the former only which is wanted in the preparation of the most perfect bougies.

To accomplish this more perfect depuration, the stearine is converted into soap, with lime, and this soap is then decomposed by dilute sulphuric acid, forming an insoluble precipitate of sulphate of lime, and leaving the crystallizable stearic acid free.

The saponification of the stearine with lime, is aided by a high temperature, (140° cent. = 284 Far.) which produces a corresponding pressure on the liquid, and by suitable agitation. The stearic acid, when separated, is thoroughly washed by hot water and steam, and then set aside to crystallize in tinned vessels.

The cakes thus obtained are broken up, put into sacks, and subjected to the gradual action of a hydraulic press. The greater part of the oleic acid is thus forced out, with a variable portion of the solid acid which it carries with it, depending on the temperature.

The material thus obtained is still more completely purged by a cold pressure in other hydraulic presses, not less powerful, but arranged horizontally. This leaves the solid matter of a splendid pearly white, exempt from odour, but not yet sufficiently purified. It is melted again in water, sharpened with sulphuric acid, washed, and cast into moulds, when it becomes a crystalline mass, and is fit for the preparation of stearine candles.

The strong tendency to crystallization presented a formidable difficulty in the moulding of the candles. In the earlier manufactory of the improved candles this difficulty was overcome only by adding twenty-five to thirty-three per cent of wax, to the purified stearic acid. This added greatly to the cost.

\* In a circular which accompanies our French journals, issued by the above patentees, it is stated, that agreeable to the best analysis, wood contains thirty-five to thirty-seven per-cent. of carbon, and that by the common mode of burning charcoal in the forests, only sixteen to seventeen per cent. is obtained. The annual consumption in France of wood, and in the reduction of iron ore, is from thirty to thirty-one millions of francs, more than one half of which, of course, is pure loss, by the common mode of carbonization. By employing the waste heat of the furnace, they are able, with a simple and not costly appendage to convert the wood into a compact charcoal, which possesses great calorific power, and represents almost the whole of the carbon contained in the wood, and preserves in addition, a portion of the hydrogen. The relative expense of the two modes is thus represented.

<i>Old Process.</i>		<i>New Process.</i>	
	Fr.		Fr.
7 cords of wood produces 40 kilolitres of coal,	42 00	3½ cords of wood, giving also 40 kilolitres of coal,	21 00
Expense of coal burning in the forest,	3 00	Transport of wood at 2½ fr. per cord,	7 00
Transport to the furnace of 40 kilolitres,	4 00	Sawing and carbonization at the furnace.	3 50
One-sixth for toll,	8 16		
	<hr/> 57 16		<hr/> 31 50

Difference in favour of the new process, 25 fr. 66c.

35\*

G.

An attempt was made at improvement by adding about a thousandth part of arsenious acid, in powder, to the stearic acid. This pretty effectually cut the crystals, (as the workmen termed it) but the process was objectionable, diffusing a disagreeable odour in apartments where many of the lights were burning.

M. de Milly now employs a more simple process, exempt from all reproach, and which requires only five hundredth parts of wax. It consists in disturbing the crystallization by a rapid transition from the liquid to the solid state, effected by dipping the moulds momentarily in water, of about the temperature of congelation of the purified material, and then pouring in the melted substance at a temperature but little higher than the melting point. This ingenious management secures to this fine improvement all the success that could be hoped for. The manufacture has become greatly extended; the wholesale price has been lowered from 2 fr. 25 c. to 1 fr. 75 c, and the retail price from 2 fr. 50 c. to 2 francs the metrical pound, while at the same time the quality of the article is much improved. A steam generator is used in De Milly's factory, for heating and in most of the mechanical operations, and about eighty people, men, women and children are employed in it.

Bull. d'Encour. Mars. 1836.

*Improved Perpetual Oven.* The silver medal was granted to *Jametet & Lemare*, for an oven, the fuel of which is placed under ground, and in large mass. The doors of the furnace and ash pit being closed, no air gains access, except what filters as it were through the masonry. By this means the combustion continues a long time. The oven being long and continuous, the air which enters it is at first much heated, but being gradually cooled by the evaporation from the bread, it descends by its gravity, and again enters the oven to renew the process, thus maintaining a continued current, which regulates the temperature.

Idem.

*The Prompt Copyist.* An ink of a particular consistency is fabricated by *M. Lanet*,—and from a page written with it, two impressions may be taken on varnished or waxed cloth. The powder of a hygrometric ink is then spread on the cloth, and adheres only to the characters impressed. The surface of the cloth is easily moistened, the dampness attaching itself only to the powder, leaving the rest of the cloth free. Two impressions are then taken from each of the proofs, making, with the original letter, five copies, all perfectly legible. The silver medal was granted to *M. Lanet*.

Idem.

*Improved Tanning.* *M. RENOU* has devised a method of tanning rabbit skins, so as to render them as thick as cow skin. With these he tans boot legs and the upper leather of shoes, so as to be without a seam, leaving the hair inside. Leggings, buskins, caps, &c. are also manufactured of this new material. Rabbit skins which before were worth but 10 centimes, now sell from 1 fr. 50 c. to 4 francs. Cat skins may be treated in the same manner. This invention obtained the platina medal.

Ibid.

*Pink Colour employed in English Porcelain.* By *M. BRONGNIART*. The beautiful English porcelain, known by the name of *Iron Stone*, is figured with a pink or purplish colour, very agreeable to the eye, the preparation of which has been kept a secret. *M. MALAGUTI*, attached to the Royal Manufactory at Sèvres, having analyzed this colour, finds it to be composed of

stannic acid 100 parts, chalk 34, oxide of chrome 1, silex 5. Combining these materials by a strong calcination, he obtained a colour at least as fine as that of the English. The trials that have been made of it at the factory of *L. Lebeuf*, at Montereau, on the fine ware called *opaque porcelain*, have perfectly succeeded.

Bull. d'Encour. Mat. 1836.

*New method of feeding calves.* M. Labbé, member of the council of administration of the Agricultural Society, finding that the carrot is one of the most nutritious kinds of food for cows, greatly increasing the quantity of milk, and furnishing a richer cream, he reduced half a pound of carrots to a pulp, boiled it four or five minutes in half a pint of water, and added the whole, in two portions, to the noon and evening mess of a calf, five days old. The same food, as a substitute for milk, was increased daily, so that on the eleventh day the boiled carrots were given as the entire food, except that after the eighth day a boiled potatoe was added to each of the three daily messes. The calf not only thrived finely, but grew so fat, that on the twentieth day, not intending it for the butcher, they were obliged to moderate the food.

Idem.

## Physical Science.

### BRITISH ASSOCIATION.

*Large lens of rock Salt.* SIR DAVID BREWSTER having been authorized to expend £80 in the construction of a lens of rock salt, stated that through the kindness and activity of Dr. Traill, he had procured from Cheshire several splendidly transparent and homogeneous crystals of rock salt; and that he had little doubt that these would in every way answer the desired end; but that, as a lens, when constructed of this material, would require to be adapted to a certain glass lens or lenses—and as the construction of each of these and their mutual adaptation was a matter requiring not only the nicest mechanical manipulation, but also a skill and knowledge of principles which was not to be expected in workmen of an ordinary class—he had most reluctantly been compelled to abstain from an attempt at the actual construction, but he hoped very soon to have it in his power to accomplish this most desirable object.

Athenæum.

*Tide observations at Liverpool and London.* M. LUBBOCK being called upon to give an account of the recent discussion of tide observations, for which a liberal grant of money had been made by the Association, rose and stated, that through the indefatigable exertions of Mr. Dessiou, considerable progress had been made in the reduction of the observations made at Liverpool by Mr. Hutchinson.

The diurnal inequality of difference between the superior and inferior tide of the same day, which in the Thames was very inconsiderable, if not insensible, was found at Liverpool to amount to more than a foot; a matter upon which the learned gentleman laid considerable stress, as calculated to lead to important practical results. The object of these reductions was to compare the results of theory with these observations, and with those of Mr. Jones and Mr. Russell, made at the port of London. The principal objects of comparison were the heights of the several tides, and the intervals between tide and tide; and these were examined in their relations to the parallax and declination of the Moon and of the Sun, and in reference to local, and what may in one sense be called accidental causes, as storms, &c.

Of this latter, one of the most curious, as well as important, is the effect of the pressure of the atmospheric column. The learned gentleman stated, that M. Daussy had ascertained, that at the harbour of Brest a variation of the height of high water was found to take place, which was inversely as the rise or fall of the barometer, and that a fall of the barometer of 0.622 parts of an inch, was found to cause an increase of the height of the tide, equal to 8.78 inches in that port. To confirm this interesting and hitherto unsuspected cause of variation, had been one principal object of the researches of the learned gentleman, and at his request, Mr. Dessiun had calculated the heights and times of high water at Liverpool for the year 1784, and compared them with the heights of the barometer, as recorded by Mr. Hutchinson for the same year; and by a most careful induction, it had turned out that the height of the tide had been on an average increased by one inch for each tenth of an inch that the barometer fell, *cæteris paribus*; but the time was found not to be much, if at all, affected. Mr. Lubbock then proceeded to examine the semi-menstrual declination and parallax correction, and stated that the result was a remarkable conformity between the results of Bernouilli's theory, and the results of observations continued for nineteen years at the London Docks. But to render the accordance as exact as it was found to be capable of being, it was necessary to compare the time of the tide, not with that transit of the Moon which immediately preceded it, but with that which took place about five lunar half days. To explain this popularly, the learned gentleman stated, that however paradoxical it might appear to persons not acquainted with the subject, yet true it was, that although the tide depended essentially upon the Moon, yet, any particular tide, as it reaches London, would not be in any way sensibly affected, were the Moon at that instant, or even at its last transit, to have been annihilated; for it was the Moon as it existed fifty or sixty hours before, which caused the disturbance of the ocean, which ultimately resulted in that tide reaching the port of London. The learned gentleman then exhibited several diagrams, in which the variations of the heights of the tide, as resulting from calculations founded upon the theory, were compared with the results of observations. The general forms of the two curves which represented these two results, corresponded very remarkably; but the curve corresponding to the actual observations, appeared the more angular or broken in its form, for which the learned gentleman satisfactorily accounted, by stating that the observations were neither sufficiently numerous, nor sufficiently precise, from the very manner in which they were taken and recorded, to warrant an expectation of a closer conformity, or a more regular curvature. When it is recollected that the observations are at first written on a slate, and then transferred to the written register, by men otherwise much employed, and whose rank in life was not such as would lead us to expect scrupulous care, it was not to be wondered at, if occasionally an error of transcript should occur, or even if the observation of one transit was set down as belonging to the next. When to these circumstances it was added, that the tide at London was in all probability, if not certainly, made up of two tides, one having already come round the British Islands, meeting the other as it came up the British Channel, it was altogether surprising that the coincidence should be so exact; and it was one among many other valuable results of these investigations, that it was now pretty certain that tide tables constructed for the port of London, by the theory of Bernouilli, would give the height and interval with a precision quite sufficient for all practical purposes, and which might be relied on as sufficiently exact,

when due caution was used in their construction, and the necessary and known corrections applied. In conclusion, Mr. Lubbock said, the Observations for the port of London had now been continued from the commencement of this century, and those for Liverpool, as we understood, about twenty-five years.

Prof. WHEWELL observed, that as, in the discussion of the relative level of land and sea, the tides of the ocean were an important element, he should preface the remarks upon that subject, which he intended to submit, by making a few observations upon the very valuable communication of his friend Mr. Lubbock. This communication he highly eulogized, and pointed out to the Section the importance of many of the conclusions, should they prove hereafter to be generally applicable; but he expressed strongly his fears that this would not be the case. Observation had, in the instance of the tides, far outstripped theory, for many reasons, which it would be impossible to detail; but among the most prominent were the complexity of the problem itself involving the astronomical theories both of the Sun and Moon; the masses of these bodies; the motions of disturbed fluids, and local causes tending to alter or modify the general geographical effect of the great tide-wave at any particular place. It was upon a careful review of these considerations, that he was led to fear that it would be still many years before theory would become so guarded and supported by local observations; as to afford a sufficiently correct guide to be implicitly relied on in these speculations. He instanced the tides of the British Channel, which, in consequence of their excessive magnitude, afforded magnified representations of the phenomena, by which the deviations become more remarkable. At the port of Bristol, the tide rose to a height of fifty feet, while towards the lower part of the Channel they only rose twenty, and along other parts of the coast not quite so high. The most striking of Mr. Lubbock's conclusions was that by which it appeared that the ocean assumed the form of the spheroid of equilibrium, according to the theory of Bernouilli, but at five transits of the Moon preceding the tide itself. By the calculations of Mr. Bent, however, it would appear, that although the observed laws of the tides at Bristol might be made to agree with Bernouilli's theory of equilibrium tides, by referring them to a certain anterior transit,—so far as the changes due to parallax were concerned, as also as far as those due to declination were concerned,—yet it turned out that this anterior period itself was not the same for parallax as for declination. The two series of changes have not therefore a common origin or a common epoch; so that in fact there is no anterior period which would give theoretical tides agreeing with observed tides; and, therefore, at least the Bristol tides do not at present appear to confirm the result obtained by Mr. Lubbock from the London tides. The learned gentleman then illustrated these views by diagrams, by the aid of which he explained to the Section the luni-tidal intervals, and the curve of semi-menstrual inequality—(this latter term, and the doctrine connected with it, was introduced into the subject of the tides by the learned gentleman himself, and, as is admitted by all acquainted with the subject, with the most valuable result.)

*Relative Level of Land and Sea.* Prof. WHEWELL then proceeded to give an account of the proceedings of the committee appointed to fix the relative level of land and sea, with a view to ascertain its permanence, or the contrary. He observed, that the Committee had not taken any active, practical steps for the important purposes for which they were appointed, be-

cause they had met with many unexpected difficulties requiring much consideration. It was, however, intended to appoint a Committee for the same purposes, who should be furnished with instructions founded upon the views at which the former committee had by their labours and experience arrived. One method proposed was, that marks should be made along various parts of the coast, which marks should be referred to the level of the sea; but here the inquiry met us in the very outset—what is the proper and precise notion to be attached to the phrase *the level of the sea*? Was it high water-mark, or low water-mark? Was it at the level of the mean tide, which recent researches seemed to establish? In hydrographical subjects the level of the sea was taken from low water, and this, although in many respects inconvenient, could not yet be dispensed with, for many reasons, one of which he might glance at—that by its adoption, shoals which were dry at low water, were capable of being represented upon the maps as well as the land. The second method proposed appeared to the learned Professor to be the one from which the most important and conclusive results were to be expected. It consisted in accurately leveling, by land survey, lines in various directions, and by permanently fixing, in various places, numerous marks of similar levels at the time; by the aid of these marks, at future periods, it could be ascertained whether or not the levels, in particular places, had or had not changed, and thus the question would be settled whether or not the land in particular localities was rising or falling. Still further, by running on those lines, which would have some resemblance to the isothermal lines of Humboldt, as far as the sea coast, and marking their extremities along the coast, a solution would at length be obtained to that most important practical question,—what is the proper or permanent level of the sea at a given place? Until something like this were accomplished, the learned Professor expressed his strong conviction of the hopelessness of expecting any thing like accuracy in many important and even practical cases. As an example, he supposed the question to be the altitude of Dunbury Hill referred to the level of the sea. If that level of the sea were taken at Bristol, where the tide rises, as before stated, fifty feet, the level of low water would differ from the same level on the sea coast at Devonshire, where the sea rises, say eighteen feet; and supposing, as is most probable, the place of mean tide to be the true permanent level by no less a quantity than sixteen feet, which would therefore make that hill to appear sixteen feet higher, upon a hydrographical map constructed by a person taking his level from the coast of Devonshire, than it would appear upon the map of an engineer taking his level at Bristol. In the method proposed, the lines of equal level would run, suppose from Bristol to Ilfracomb in one direction, and from Bristol to Lyme Regis in the other, and by these a common standard of level would soon be obtained for the entire coast.

Professor Sir William Hamilton rose to express the sincere pleasure he felt at the masterly expositions of Mr. Lubbock and Professor Whewell. One conclusion to which Mr. Lubbock had arrived was to him peculiarly interesting, viz. that by which it appeared that the influence of the Moon upon the tides was not manifested in its effects until some time after it had been exerted, for a similar observation had recently been made by Professor Hansteen respecting the mutual disturbances of the planets.—Mr. Lubbock rose to say, that the agreement between the results calculated from the theory of Bernouilli and those obtained from actual observation, were much more exact than Professor Whewell seemed to imagine; in truth, so close was the

agreement, that they might be said absolutely to agree, since the difference was less than the errors that might be expected to occur in making and recording the observations themselves.—Mr. Whewell explained that he wished to confine his observations to the Bristol tides, as these were the observations to which he had particularly turned his attention; and, with respect to which, he should be able, at the present meeting, to exhibit diagrams to the section, which he felt confident would amply bear out his assertions respecting these tides.—Mr. Lubbock stated, that so near, indeed so exact, had been the coincidence between the observations made at London and Liverpool, and the theory, that he was strongly inclined to believe that that coincidence would be found at length to be universal.—Professor Stevelly inquired from Mr. Lubbock, whether he did not think it quite possible that local causes might exist, which would be fully capable of producing the deviations from the theory of Bernoulli; as, for instance, in the case of Bristol, so ably insisted upon by Professor Whewell, where the causes of the extraordinary elevation are the land-locking of the tide-wave, as it ascends the narrowing channel, and the reflexions of other tide-waves from several places. Now, particularly in the case of reflex tides, may it not so happen, and does it not, in fact, happen in several places, that they bring the actual tide to a given port at a time very different from that at which the influence of the Moon and Sun, if unimpeded, would cause it to arrive, and thus separate, as Professor Whewell had stated, the origin or epoch of the variations due, suppose to parallax and declension, and even cause other deviations from Bernoulli's theory?—Mr. Lubbock replied, that unquestionably it might so happen; but, in his opinion, the discussion of a few observations, like those made at Bristol, could not be expected to point out very exactly the origin or epoch of either of the variations of parallax or declination, with sufficient exactness, to furnish secure data for determining that they did not correspond to any one, common, previous transit of the Moon.

*Jerrard's Mathematical Researches.* Prof. SIR WILLIAM HAMILTON read his report on Mr. George B. Jerrard's mathematical researches, connected with the general solution of algebraic equations. He wished, in the first place, to inform the Section, that no part of the grant of 80*l.* had been expended, which the Association had so liberally placed at his disposal for the purpose of procuring the assistance of persons competent to verify, by numerical computations, the method of Mr. Jerrard. The reason that he had not deemed it necessary to resort to this expense was, that he had, at a very early period after the meeting of the British Association in Dublin, satisfied his own mind that the method of Mr. Jerrard entirely failed in accomplishing the solution of equations of the fifth and sixth degree; and he trusted that he should be able to lay before the Section, with as much clearness as the abstruse nature of the subject would admit of, the principal steps of a demonstration, which, to the mind of the learned Professor himself, at least, carried a complete conviction, that the method of Mr. Jerrard was not applicable until the equation, as a minor limit, had reached the seventh degree. In order that he might carry the Section fully along with him, Professor Hamilton stated, that it would be necessary to give again a rather detailed account of the peculiarities of the very ingenious notation, devised by Mr. Jerrard, for denoting certain algebraic processes, resorted to in the application of his method. The Professor then proceeded to detail to the Section the several steps of Mr. Jerrard's method, clearly marking the steps

previously known to analysts, and such as Mr. Jerrard had the merit of originating. The principal peculiarity of *formulæ* seemed to be, that in an equation, transferred in a particular manner for the purpose of eliminating the co-efficients of the original equation, the co-efficients were so ingeniously obtained as to be entirely independent of the degree of the original equation, and therefore to be of a similar form in all possible equations, the solutions of which were sought. As soon as he had prepared these formulæ, the Professor proceeded to demonstrate to the Section, that from the very nature of their connexion with the original equation, they must fail in giving its solution, where it only rose to the fourth dimension, because he showed that this would involve the solution of an equation of the sixth degree, as a preliminary step. Equations, however, of this degree had been long solved, and it was only, therefore, in connexion with the generality of Mr. Jerrard's method, that its failure, as regarded them, was of any consequence. He then proceeded to give a similar demonstration of its failure, as regarded equations of the fifth and of the sixth degree; and during his discussion of this step of his demonstration, he took occasion to show that Mr. Jerrard's method had succeeded in reducing equations of the fifth degree to tables of double entry—a discovery, upon the value of which he enlarged considerably, and highly eulogized and complimented the author; insomuch, that he stated that if the method had accomplished nothing but this alone, Mr. Jerrard would have received the congratulations of the scientific world. He then proceeded to show, that unless the index of the equation reached as a minor limit the number seven at least, a certain intermediate equation, concerned in the elimination, would be met with, along with a multiple of it, which, therefore, would not give a number of distinct results sufficient to complete the eliminations; but, beyond that degree, he stated that he had satisfied himself that Mr. Jerrard's method would afford solutions of equations, which, even if they should, from their complexity, or other causes, be useless to the practical or merely arithmetical algebraist, yet to those engaged in prosecuting inquiries involving purely symbolic algebra, he felt confident they would afford facilities and general methods of investigation, hitherto almost unlooked for and unexpected.

Mr. Babbage complimented Sir W. Hamilton upon the very lucid exposition which he had given of a subject which he characterized as bordering upon the very extremest limits of human knowledge, and congratulated Mr. Jerrard upon the success with which he had contrived so effectually to distinguish between the symbols of operation and those of quantity, in expressing the results of elimination. Engaged, as it was well known he was, in a branch of practical numerical science, he could not suffer himself to be supposed to look with indifference upon a discovery which, if it should even fail in affording any practically important assistance to his particular branch, must yet be admitted to afford the strongest promise of advantage to the more purely abstract branch of algebraic investigation.—Professor Peacock observed, that during the progress of the discussion of this question he had not failed to remark the many advantages which must result to algebra from Mr. Jerrard's method, from the collateral improvements to which the prosecution of his principal object had led, partly in suggesting new, and hitherto unexplored, methods of elimination, and partly by leading to a notation, which so clearly distinguished between the marks of quantity and the observations and changes which were to be resorted to in reference to them; but as to the result itself, he need characterize it no higher, when he added, that it was an advance in the science, which it did not appear that the cele-

brated La Grange had ever contemplated, and which was not approached by the result of Stchernhausen.

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*Experiments with a view to determine the Interior Temperature of the Earth.* Prof. PHILLIPS stated that this subject had for a long period engaged the anxious attention of scientific men, both at home and upon the continent; that the most accurate, as well as numerous, experiments indicated a decided elevation of temperature as a more depressed station below the earth's surface was attained; even when the depths descended to were small, this elevation of temperature became large enough to arrest attention; in fact, the temperature of the air, of the water, of the rocks, and of the soil, was found to augment as we descended. But in order to ascertain, if possible, what portion of this heat arose from, or was connected with, an elevated temperature of the internal parts of the globe, as well as to ascertain whether the causes of these were local or universal, and, if possible, to arrive at the law of its distribution, it was deemed a matter of much importance to get rid altogether of the effect of the air's temperature upon the thermometer, as also the action of water, because the sources of the water in mines, &c. must be in most cases entirely beyond the reach of observation. All these circumstances induced the committee appointed by the Association to conduct experiments upon this subject, to take the temperatures of the rocks themselves alone, as the fundamental experiments. With this view, they had no less than thirty-six thermometers made and carefully compared, and, although they well knew that these thermometers, after all the care which had been bestowed upon their construction, were by no means perfect or exact, yet, as their errors had been carefully noted, by a comparison with the standard thermometers of the Royal Societies of London and Edinburgh, and each thermometer numbered, the errors admitted of an easy correction. Many of these thermometers had been already placed under the care of persons adequately instructed to conduct the requisite experiments, and some of them were still in the possession of the committee, who would gladly place them in the charge of any person giving adequate security that they should be applied to the purpose for which they had been procured. The method of using them was this: a hole large enough to receive one of the thermometers, was first drilled into the solid rock, at the bottom of the mine, pit, or other proper place of observation, to the depth of two or three feet at least; into this the thermometer was then introduced and suffered there to remain for a number of days sufficient to ensure the attainment of the temperature of the rock itself. The temperature of the air at the mouth of the pit, and, if possible, the mean temperature of the place, must be observed or obtained. Professor Phillips then stated, that observations had been made in this manner, and with some of these instruments, under the directions of Professor Forbes, at mines in the Lead Hills, in Scotland, and that Professor Forbes would take some early opportunity of bringing these observations more immediately under the notice of the Section; at Newcastle, under the direction of Mr. Briddle; at Wearmouth, under the care of Mr. Anderson; near Manchester, and at Northampton, under the direction of Mr. Hodgkinson; and within a few days, Professor Phillips had been enabled, through the kindness of a friend, to place a thermometer in a deep coal mine at Bedminster, in this immediate vicinity (Bristol.) The results of these observations, so far as they had as yet proceeded, amply confirmed the fact of the increase of temperature in the parts under the earth's surface. As one example, the Professor

stated, that in a mine, the perpendicular depth of which, below the surface, was 525 yards, the thermometer in the rock stood at  $78^{\circ}$ , while the temperature in the open air at the mouth of the mine, varied from  $30^{\circ}$  to  $80^{\circ}$ , the mean temperature of the place being  $47\frac{1}{2}^{\circ}$ .

Prof. Forbes then gave, from memory, an account of the experiments which he had been the means of instituting in the Lead Hills. Before he did so, however, he wished to state that he had been informed that an artesian well had lately been met with in granite, and he then gave a general description of artesian wells. It was to this effect; that heretofore, in making borings in certain districts through certain alternations of clays, and at length through certain rocks, a supply of water was reached, which rapidly rose through the boring to the surface, and continued to overflow at the top sometimes, as the term fountain indicated, in considerable quantity, and with considerable force. He instanced the artesian wells, or fountains, of the London clay districts; and added, that the temperature of these waters was found universally to increase with the depth of their source beneath the surface of the earth. Heretofore, no such well had been obtained by boring through the granite; and if the account, which he had received, were correct, and of its correctness he entertained little doubt, this would be a matter of considerable interest as well to the geologist as to those who were engaged in scientific pursuits similar to those now under consideration. The observations made under his direction in the Lead Hills, alluded to by Professor Phillips, were almost entirely conducted by Mr. Irvine. These observations were particularly interesting, from the fact, that the mines, in consequence of a strike among the workmen, had not been worked for many months, and at the same time it most fortunately happened that they were self drained, that is, by machinery worked by external power, without the aid of either animals or steam. This most fortunate concurrence of favourable circumstances, which could be expected to be met with in so very few instances, at once disembarassed the observations from many sources of error, which, but for this, would have still left considerable doubts of the results being, partially, at least, affected by the heat generated by animals residing and working in the mines, as well as of artificial fires kept up for the purposes of ventilation or of originating power. It was upon these grounds that he perceived the importance of them, but had it not been for the valuable assistance afforded him by Mr. Irvine, who descended into the mine, and placed the thermometer and made the observations, he could scarcely have been as successful as the results already obtained warranted him in hoping he should be. These results, which, of course, had not as yet reached the degree of accuracy which he still looked for, lead to the conclusion that the temperature in that mine increased about 50 of Fahrenheit for a descent of ninety-five fathoms.—Professor Stevelly stated, that as practical utility was one of the principal objects of the British Association, he might be permitted to add, that the waters of these wells, in consequence of their temperature being in general elevated above the mean temperature of the place at which they delivered their waters, had been applied to the very important practical purpose of freeing machinery of ice in winter, insomuch, that by their instrumentality, machinery, such as water wheels, &c., which had always previously been clogged by ice for a considerable part of the winter, to the great loss of the owner's manufactory, were, by the aid of the waters of these fountains, kept constantly free; while the same water has been, in some instances, conducted through the factory itself, with a view to keep up a uniform and elevated temperature

within its walls, thus affording a second and a very valuable practical application.

London Athenæum, No. 461.

## Progress of Civil Engineering.

### Health of Cities—Improvement of London.

Our last number contained the substance of a Report on the plan of a celebrated artist, J. Martin, for the improvement of the British Metropolis, preceded by some general remarks on the importance of a due consideration of the plans upon which our own cities are regulated, in reference to salubrity and comfort. We now insert the strictures which have been made upon Martin's scheme of improvement, by a writer in the London Architectural Magazine.

“That we have thought on the different subjects treated of in this Report, will appear evident from two articles; the one, *A Plan for saving the Manure lost in the common Sewers of London, and rendering the Thames Water fit for domestic Purposes*; and the other, *On Breathing Places for the Metropolis, and other Towns*, which appeared in the *Gard. Mag.*, vol. v., for 1829. It will be seen, even from the titles of these articles, that we approve of the general principle of preventing the London sewers from emptying themselves into the Thames; and of saving every particle of the manure which they contain. We differ, however, from Mr. Martin, in preferring several intercepting sewers to one, which one, from its unavoidable magnitude, we think would be liable to very great risks in times of heavy rain, or severe frost, notwithstanding the precaution of flood-gates; which, even if found efficacious, would, in a great measure, defeat the purpose of the sewer, by contaminating the water of the Thames.

Another difficulty regarding Mr. Martin's plan, is the quantity of sewer water that will require to be either evaporated, or run off, from the manure reservoirs. This quantity would necessarily be immense, and may be estimated by the quantity brought into London by the different water companies, or obtained from wells, &c., in addition to what falls from the clouds. If this water is neither evaporated nor run off, then the contents of the sewers must be conveyed in their present state to the grounds where they are to be employed as manure; but to convey all the water contained in the sewers of London in “covered barges, or properly constructed land-carriages,” may be safely pronounced impracticable. We have no doubt of the utter impossibility of evaporating this water during the winter months, and, consequently during that season at least, it must be run off. Mr. Martin has not stated how he means to dispose of it. It is certain that, if it found its way into the Thames any where above Gravesend, it would, from the influx of the tides, contaminate the water as far as London and, if it remained in ponds in the neighbourhood of the reservoirs of manure, it would cover great part of the surface of the Essex marshes. The superfluous water, we think, would be best got rid of by running it off from the manure reservoirs into an open sewer, parallel to the Thames, and continued as far as the sea, and then allowing it to escape among the sea water, which is already unfit for human use. The salt seas, then, in every part of the world, appear to be the only natural cess-pools, or reservoirs, for the sewers of great cities; and, unquestionably, the only true principle of arranging the sewerage of all cities, towns, and even villages, which are built

along the banks of rivers, is by forming sewers parallel to those rivers, and not so far from them as to occasion any difficulty in the sewers receiving the drainage of the space between them and the margin of the river.

If the building of London were to be recommenced, the first step should be to form two sewers parallel to the Thames, though at such a distance from it as to admit of forming docks, basins, &c., on its banks; but, as this has not been done, the question is (now that the ground is covered with houses and streets, and various docks, basins, and canals,) how to remedy the evil? We are inclined to think it will be better done by two or three intercepting sewers, at different distances from the Thames, than by one so close to that river, and so large, as that which Mr. Martin proposes. One sewer might be carried at about the distance of the Strand, more or less, as might be convenient; a second, about the distance of Holborn, which should intercept all the sewers between it and a third, about the distance of the New Road, which should, in like manner, intercept all the sewers northwards. The directions of these sewers must necessarily vary with the inclination of the surface, so as to keep the bottom of each sewer of one uniform declivity; and they might all unite in an open sewer, or ditch, a few miles down the river, which ditch might be continued to the sea, or to the point where the water of the Thames became decidedly salt. Where the sewer met with rivers or canals, it might cross beneath them in inverted siphons, such as those employed in conveying the water used in irrigation in Lombardy. Indeed, a considerable part of the water of this sewer, and, possibly, at some seasons of the year, the whole of it might be employed in irrigation; in which case it should be raised from the sewer by machinery, impelled by steam, and conveyed to the fields intended to be irrigated by open ditches, or in pipes. By the latter mode, it might be conveyed many miles in the interior, even over a hilly country: and, perhaps, such a mode of irrigation would even now pay the British cultivator.

If intercepting sewers of the kind described were to be carried into effect in London, they might all be so deep under ground as to be excavated by tunneling, and, consequently, the surface, and the buildings on it, would be scarcely at all disturbed. The expense, also, of this mode of excavating sewers, we think, might be more readily ascertained than that of forming one immense tunnel in Mr. Martin's manner; as it could not vary much from that of the present ordinary sewers. One obvious advantage of this mode of forming intercepting sewers is, that, by dividing the water to be conveyed away into different portions, there never could be any danger from the stoppage of a sewer, at all to be compared to that which would result from the bursting of one main sewer, which should contain the contents of all the sewers of the metropolis on one side of the river. Another advantage is, that, by having the intercepting sewers considerably deeper than the ordinary ones, there would be no occasion to stop up the ends of the ordinary sewers which crossed them; in consequence of which, if any intercepting sewer were at any time choked up, the superfluous water would readily find its way through the ordinary sewer, into the next intercepting sewer, or, at all events, into that which was on a lower level. Again, a system of intercepting sewers would not interfere with any of the docks, or with the canals which join the river, which the scheme of a single sewer adjoining the Thames, we think, would certainly do.

If such a system of sewerage were formed on the intercepting principle, or, indeed, on any other, to be effective in preserving the purity of the water of the Thames, it must be commenced above Brentford, or rather,

perhaps, at Oxford, and continued, at least, for some miles below Gravesend. Wherever the sewer did not pass through towns or villages, it might be an open ditch; and it would form, during its whole length, a valuable source of liquid manure to the adjoining lands. Of course, it could easily be carried under rivers, streams, or canals, connected with the Thames, by the mode already suggested; and such proprietors as chose might have a covered ditch instead of an open one. Other proprietors might have iron pipes, even though they lived at several miles distance, communicating with the sewer; and, by applying pumps to these pipes, they might obtain water for the purposes of irrigation at pleasure.

We shall, perhaps, surprise our readers when we state, as our candid opinion, that we do not think the "magnificent promenade on each side of the river, to be formed by the conversion of the roofs of the colonnaded wharfs into parapeted walks," would be at all desirable. A quay, or broad terrace walk, along the banks of the river, we think, would be highly so; but to stop up the ends of the streets by this colonnade, and its parapeted roof, would, we think, prevent their proper ventilation; and we are sure that it would totally destroy the beautiful views of the river, now obtained by looking down them; which views, in a large city, more particularly in summer, are peculiarly refreshing to the sight, from the idea of coolness conveyed by the vast expanse of water, as contrasted with the dust and heat of the streets. Were such a colonnade and public walk executed, there can be no doubt it would produce a very grand impression at first sight; but by no means so much so as might be imagined. This, a little reflection will convince any philosophic architect, must necessarily arise, from the circumstance of its ground plan having neither regularity nor symmetry; that is, of its consisting neither of one or more straight lines, nor of one or more regularly curved lines, nor of such a combination of these as would suffice to form a symmetrical whole. In the absence of both regularity and symmetry, the monotony of the impression of grandeur would, we think, soon become wearisome. In proof of this, we may refer to the elevations of the houses in the streets on the banks of the Spree, at Berlin; to those on the banks of the Neva, at St. Petersburg; and even to those on the banks of the Arno, in some parts of Florence and Pisa. If, instead of the proposed colonnaded quay, we had only an architectural basis, such as would be formed by a river wall, like those in the cities mentioned, and a broad promenade within it, we should, in the elevations of the houses facing the river, greatly prefer the variety that would be produced by the mixture of public and private buildings, by the different purposes for which both were erected, and by the wealth, taste, and even no taste, of the erectors, to any regular design whatever. In short, we are of opinion that Mr. Martin's colonnade, grand and sublime as we allow it to be, if executed on either, or on both sides of the Thames, would take away half the interest and variety which at present attaches to that river.

By adopting the principle of having sewers parallel to all rivers and streams throughout the whole of their course, every particle of manure, and more especially of liquid manure, would be saved. In thinly inhabited countries, sewers of this kind are out of the question; but in such as are densely peopled they seem to be absolutely necessary for the preservation of the purity of the water of the rivers. There must, we think, be something radically bad in the geographical police of a country, in which not only the water of all the rivers is more or less polluted, but in which an

immense quantity of the most valuable description of manure is habitually and irrecoverably lost.

If a system of intercepting sewers were adopted, extending from Brentford or Windsor to Gravesend, there could be no difficulty in supplying London with pure water from the Thames. If, on the other hand, the system of making all the rivers of a country serve as its main sewers, as is at present the case, not only in Britain, but throughout the world, is to be persevered in, it may be reasonably pronounced impossible ever to obtain perfectly pure water in large quantities, in densely peopled countries; since every part of the rivers of such countries must contain more or less of those fæcal impurities, which, according to Dr. Granville, neither subsidence nor fermentation will remove.

With this view of the subject, we do not approve of Mr. Martin's plan of forming a dam across the Thames, and supplying the metropolis from the water above it, for though we admit that this water is much more pure than that of the Thames opposite London, yet still it would contain all the impurities of Brentford, and the tributary sewers from the intervening villages. Mr. Telford's plan is not without objections of the same kind: in short, there is no plan by which immense quantities of perfectly pure water can be obtained in a densely peopled country like England, but by preserving the purity of the rivers by intercepting sewers, or by raising the water from inferior strata, in which there may prove to be an abundant supply. When we consider the advantage that would arise from saving and applying to the surface of the soil the immense quantity of liquid manure now utterly lost, and, at the same time, the desirableness of having pure water in all large cities, we cannot help thinking that the subject of intercepting sewers deserves the attention of government, and of the proprietors of lands in the country, no less than of the dwellers in towns.

Mr. Martin's plan for a parapeted public walk by the side of the river is magnificent; but, as we have already stated our objections to the proposed structure, it is unnecessary here to add anything more respecting it. An uncovered parapeted quay, like that which borders both sides of the Neva, at St. Petersburg, we should wish to see carried along both banks of the river; and this, besides facilitating business in business hours, would form an excellent promenade in the evenings, and on Sundays.

In the year 1829, in consequence of an attempt made in parliament to procure a bill for enclosing Hampstead Heath, our attention was directed to the subject of public walks and breathing places; and the following is an extract from an article which appeared in the *Gardener's Magazine* for that year;—

"A late attempt in parliament to enclose Hampstead Heath has called our attention to the rapid extension of buildings on every side of London, and to the duty, as we think, of government to devise some plan by which the metropolis may be enlarged so as to cover any space whatever with perfect safety to the inhabitants in respect to the supply of provisions, water, and fresh air, and to the removal of filth of every description, the maintenance of general cleanliness, and the despatch of business. Our plan is very simple; that of surrounding London, as it already exists, with a zone of open country, at the distance of say one mile, or one mile and a half, from what may be considered the centre, say from St. Paul's. (*fig.* 143.) This zone of country may be half a mile broad, and may contain, as the figure shows, part of Hyde Park, the Regent's Park, Islington, Bethnal Green, the Commercial Docks, Camberwell, Lambeth, and Pimlico; and it may be suc-

ceeded by a zone of town one mile broad, containing Kensington, Bayswater, Paddington, Kentish Town, Clapton, Lime House, Deptford, Clapham, and Chelsea: and thus the metropolis might be extended in alternate mile zones of buildings, with half mile zones of country or gardens, till

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| 1. Finchley common; in the zone of coun-<br>try. | 27. Green Park; country.     |
| 2. Tottenham; in the zone of town.               | 28. Southwark; town.         |
| 3. Walthamstow; town.                            | 29. London Docks; town.      |
| 4. Forrest House; town.                          | 30. West India Docks; town.  |
| 5. Stoke Newington; town.                        | 31. Woolwich; town.          |
| 6. Highgate; country.                            | 32. Isle of Dogs; town.      |
| 7. Hampstead; country.                           | 33. Greenwich Park; country. |
| 8. King'sbury; country.                          | 34. Deptford; town.          |
| 9. Wildsdon; town.                               | 35. Walworth; town.          |
| 10. Kentish Town; town.                          | 36. Brompton; town.          |
| 11. Clapton; town.                               | 37. Kensington; town.        |
| 12. Hammersmith; town.                           | 38. Hammersmith; town.       |
| 13. Stratford; country.                          | 39. Lambeth; country.        |
| 14. West Ham; country.                           | 40. Kennington; country.     |
| 15. West Ham Abbey; country.                     | 41. Camberwell; country.     |
| 16. East Ham; town.                              | 42. Peckham; town.           |
| 17. Bethnal Green; country.                      | 43. Dulwich; town.           |
| 18. Hoxton; town.                                | 44. Clapham; town.           |
| 19. Islington; country.                          | 45. Fulham; country.         |
| 20. Somers' Town; country.                       | 46. Putney; town.            |
| 21. Regent's Park; country.                      | 47. Roehampton; country.     |
| 22. Paddington; town.                            | 48. Wandsworth; town.        |
| 23. Paddington canal; town.                      | 49. Wimbledon Park; country. |
| 24. Six Elms; town.                              | 50. Tooting; town.           |
| 25. Bayswater; town.                             | 51. Norwood; town.           |
| 26. Hyde Park; country.                          | 52. Sydenham; town.          |

one of the zones touched the sea. To render the plan complete, it would be necessary to have a circle of turf and gravel in the centre of the city, around St. Paul's, half a mile in diameter. In this circle ought to be situated all the government offices, and central depots connected with the administration of the affairs of the metropolis. That being accomplished, whatever might eventually become the extent of London, or of any large town laid out on the same plan and in the same proportions, there could never be an inhabitant who would be farther than half a mile from an open airy situation, in which he was free to walk or ride, and in which he could find every mode of amusement, recreation, entertainment, and instruction.

"Supposing such a plan considered desirable, it could not, perhaps, be carried into execution in less time than 50 or 100 years, on account of the large sums that would be required for purchasing the valuable houses that must be pulled down to form the central circle of turf, and the first zone of country. But, were government to determine the boundaries of certain future zones, and to enact a law that no buildings now standing on the future zones of country should be repaired after a certain year; and that, when such houses were no longer habitable, the owners should be indemnified for them by the transfer of other houses of equal yearly value in another part of the metropolis, belonging to government; the transition (considering the alteration in the value of property which is likely soon to take place, in consequence of the numerous rail-roads, &c., now going forward,) would not be felt as the slightest injustice or inconvenience. Government would be justified in adopting a plan of this sort, from its obvious reference to the public welfare; and a committee appointed to carry the law into execution should begin by purchasing such lands as were to be sold in the outskirts of the metropolis, in order to be able, at a future period, to exchange them for lands destined to form the central circle of the first zone. In endeavouring to give an idea of the situation of the zones round London, (fig. 143,) we have drawn the boundary lines as perfect circles; but, in the execution of the project, this is by no means necessary, nor even desirable. The surface of the ground, the direction of streets already existing, which it would not be worth while to alter, the accidental situations of public buildings, squares, and private gardens, with other circumstances, would indicate an irregular line, which line would at the same time be much more beautiful as well as economical."

In judging of the remarks in this and the preceding page, it must be recollected that they were written in 1829.

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### **Mechanics' Register.**

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*Rail Road Iron.* The iron that will be required for rails, chairs, and carriages, and other works for the roads for which bills were obtained during the last session of Parliament, will amount to at least 220,000 tons, and for bills previously obtained, 70,000 tons, making a total of 290,000 tons, which will probably be in requisition for the next four years. With respect to the United States rail roads, we find by the *American Rail Road Journal*, that the extent either actually under contract, or in progress of being surveyed, amounts to more than 3000 miles. To lay a double line this distance will take 750,000 tons of iron.

Lon. Min. Jour.

*British Hardware.* It appears from Parliamentary returns, that the

quantities of foreign iron imported into the United Kingdom in 1835, amounted to upwards of 21,150 tons, while the amount of British bar iron exported was 94,383 tons, and of other kinds of iron an amount which made the grand total 194,590 tons. A document from the custom house, entitled a "Return of British hardware and cutlery exported from the United Kingdom in the year 1835," makes the total amount 20,197 tons, the value of which was £1,833,042. Of this amount 11,062 tons, value £978,491 was sent to the United States. The whole amount for 1835 was an increase of 23 per cent. on that of the preceding year. Since 1820 the exports of hardware and cutlery have doubled in value. The exports of every description of hardware, with iron and steel, wrought and unwrought, amounted in value to £3,789,206, in 1830; and last year to £6,154,625.

Ibid.

*Light Lace Veils.* Mr. Babbage gives the following account of the lace made by the *phalæna pandilla*, a caterpillar. The invention is by a gentleman of Munich. He makes a paste of the leaves of the plant which is the usual food of the species of caterpillar he employs, and spreads it thinly over a stone or other flat substance; then, with a camel-hair pencil dipped in olive oil, he draws upon the coating of paste the pattern he wishes the insects to leave open. The stone being placed in an inclined position, a species of caterpillar which spins a strong web is laid at the bottom, and the insects commencing from that point, cut and spin their way up to the top, carefully avoiding any part touched by the oil, but devouring all the rest of the plant. These veils have not a great deal of strength, but they are surprisingly light. One of them, measuring twenty-six inches and a half by seventeen inches, weighed only 1.51 grain; a degree of lightness which will appear more strongly by contrast with other fabrics. One square yard of the substance of which these veils are made weighs  $4\frac{3}{4}$  grains, whilst one square yard of silk gauze weighs 137 grains, and one square yard of the finest patent net weighs  $622\frac{1}{2}$  grains.

Ibid.

*Embossing on Wood.* The following method of embossing on wood, invented by Mr. Straker, is extracted from the *Transactions of the Society of Arts*; it may be used either by itself or in aid of carving, and depends on the fact, that, if a depression be made by a blunt instrument on the surface of wood, such depressed part will again rise to its original level by subsequent immersion in water. The wood to be ornamented having first been worked out to its proper shape, is in a state to receive the drawing of the pattern; this being put in, a blunt steel tool, or burnisher, or die, is to be applied successively to all those parts of the pattern intended to be in relief, and at the same time is to be driven very cautiously without breaking the grains of the wood, till the depth of the depression is equal to the subsequent prominence of the figures. The ground is then to be reduced by planing or filing to the level of the depressed part, after which the piece of wood being placed in water, either hot or cold, the parts previously depressed will rise to their former height, and will thus form an embossed pattern, which may be finished by the usual operation of carving.

Ibid.

*Liverpool and Manchester Rail-way.* The company opened their new tunnel, at the entrance of the rail-way at Liverpool, to the public, on Monday last. The tunnel is a mile and one-third in length, it is twenty-one feet high, and the span of the arch is twenty-five feet. The tunnel from one end to the other is cut out of the solid rock, which, in some places, rises as high as the spring of the arch. The crown of the arch is composed of very

strong brick work. The cost of this laborious undertaking amounted to 150,000*l*. It will be attended with great convenience to the public, as the former station was about two miles from Liverpool. It occupies about six minutes for a full train to pass through the tunnel.

Ibid.

*An International Rail-way Company* has been provisionally formed for connecting London with Brussels and Paris by rail roads, via. Dover and Calais, with various branches. This measure appears to receive the sanction of all the governments concerned. The capital is estimated at £4,500,000, to be raised in England, France and Belgium. The greater part of the surveys have been already made.

Abstract—Ibid.

*Floating Wood.* The prodigious quantity of wood brought by the sea to Iceland is thought by M. Eugene Robert to come from two continents at least. Trees are thrown ashore there, sometimes without roots, and without bark, the latter being frequently found by the side, folded like a roll of parchment. M. Robert has not been able to procure any floating fruits, but he has ascertained that mahogany is often landed in Iceland in the above manner.

Ibid.

*Tea-pots made by steam.* Britannia metal tea-pots are now made by steam; the round bodies are spun, and the wooden handles and knobs are cut up by powerful steam engines. A good workman can spin twenty dozen of pot-bodies in a day.

Ibid.

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*List of American Patents which issued in July, August, September and October, 1836.*

The subjoined list of patents commences with those issued under the new patent law; we have heretofore numbered them from the first of January, to the end of the year, and shall hereafter pursue the same course, but on the present occasion we commence a new series with the new system.

Applications for patents now undergo a strict examination in the office, before they are granted; and upwards of three-fourths of those examined have, under the provision of the existing law, been deemed imperfect, and returned for amendment, or rejected for want of novelty. This, together with the delay incident in establishing a system of procedure altogether novel, accounts for the smallness of the number granted since its adoption.

*July.*

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|--|----|
| 1. <i>Locomotive engines.</i> —John Ruggles, Thomastown, Maine.      | 13 |
| 2. <i>Wool, &amp;c. manufacturing.</i> —John Goulding, Boston, Mass. | 29 |

*August.*

- |  |    |
|--|----|
| 3. <i>Turning sheaves, &amp;c.</i> —Thomas Blanchard, city of New York.                | 1  |
| 4. <i>Rounding the edges, &amp;c. of a block.</i> —Thomas Blanchard, city of New York. | 10 |
| 5. <i>Boring and mortising the shells for do.</i> —Thomas Blanchard, city of N. York.  | 10 |
| 6. <i>Plank blocks, forming.</i> —Thomas Blanchard, city of New York.                  | 10 |
| 7. <i>Boring holes and scoring dead-eyes.</i> —Thomas Blanchard, city of New York.     | 10 |
| 8. <i>Cutting scores round blocks, &amp;c.</i> —Thomas Blanchard, city of New York.    | 10 |
| 9. <i>Riveting plank blocks.</i> —Thomas Blanchard, city of New York.                  | 10 |
| 10. <i>Dye woods, cutting.</i> —Beriah Swift, Washington, N. Y.                        | 10 |
| 11. <i>Double speeder for roving.</i> —Aza Arnold, N. Providence, R. I.                | 10 |
| 12. <i>Veneers, laying.</i> —John Soule, New Bedford, Mass.                            | 31 |
| 13. <i>Polishing wire for reeds.</i> —Arnold Watkinson, Providence, R. I.              | 31 |

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14. Cotton planter.—Henry Blair, Glenn Ross, Maryland.	31
15. Caoutchouc, applying.—Edwin M. Chaffee, Roxbury, Mass.	31
16. Cutting sheaves, &c.—Thomas Blanchard, city of New York.	31
17. Countersinking for bushes.—Thomas Blanchard, city of New York.	31
18. Forming cheeks of plank.—Thomas Blanchard, city of New York.	31
19. Springs for saddles.—William Duchman, Morgantown, Penn.	31

## September.

20. Granite dressing machine.—William Morse, Corrina, Maine.	8
21. Expansion and contraction of metals, applying.—Hazard Knowles, Hartford, Conn.	8
22. Furnace for buildings.—Frederick A. Frieckardt, Easton, Penn.	8
23. Mortising machine.—David Clark, Brooklyn, Conn.	14
24. Sawing shingles.—Jonathan Hobbs, jr. Falmouth, Maine.	14
25. Silver spoons, making.—Josephus Brockway, Troy, N. Y.	20
26. Paints, composition of.—Harman Hibbard, Darien, N. Y.	20
27. Cylinders.—Henry P. Howe, Shirley, Mass.	20
28. Lamp for spirits.—Isaiah Jennings, city of New York.	22
29. Power loom, take up motion.—Horace Hendricks, Killingly, Conn.	22
30. Light, production of.—Isaiah Jennings, city of New York.	22
31. Ever pointed pencil case.—Jacob J. Lownds, Philadelphia.	22
32. Stove.—John Harriman, Haverill, Mass.	29
33. Steam boiler.—Jos. W. & Elias Strange, Taunton, Mass.	29
34. Saw mill crank.—Benj. F. Snyder, Elmira, N. Y.	29
35. Breaks for wagons, &c.—Henry West, Quincy, Mass.	29

## October.

37. Boot crimper.—Ebenezer G. Pomeroy, Newark, Ohio,	1
38. Purifying water.—Moody Park, Madison, Indiana.	4
39. Double hydrostatic oil press.—Orestes Badger & Orrin Lull, Waterloo, N. York.	5
40. Hand printing press.—Frederick J. Austin, city of New York.	8
41. Lamps.—Alonzo Platt, Middletown, Conn.	8
42. Lathe for turning.—Enos & Nelson Alvord, Westfield, Mass.	11
43. Rectilinal changed to circular motion.—Benj. Babbitt, Bangor, Maine,	11
44. Shelling corn.—Joseph C. Baldwin, Staunton, Virginia.	11
45. Window fastenings.—N. Hall & Jotham Chase, Maine,	11
46. Weaving stock bodies.—Conrad Kile, Philadelphia,	11
47. Turn-out for rail roads.—John Talbot, Portsmouth, Virginia,	11
48. Drying and burning saw dust.—William Avery, Syracuse, N. Y.	11
49. Stoves and fire places.—Jordan L. Mott, city of New York.	11
50. Endless chain carriage for saw mills.—James Murray, city of Baltimore,	11
51. Pad for coach harness.—Andrew Deitz, Albany, N. Y.	14
52. Combined plough.—Samuel Cline, Berks county, Penn.	15
53. Maning and applying fire in locomotives.—Matthias W. Baldwin, Philad.	15
54. Horse power.—Orestes Badger, Cooperstown, N. Y.	15
55. Door plates.—Ithiel S. Richardson, Boston, Mass.	15
56. Combing hemp, flax, &c.—Samuel Couillard, Boston, Mass.	19
57. Horse power.—Daniel Fitzgerald, New York.	19
58. Razor case and sharpener.—E. M. Pomeroy, Wallingford, Conn.	19
59. Putting up rope yarns.—James H. Echols, Lynchburg, Virginia.	20
60. Weavers' harness, making.—John Blackman, Brooklyn, Conn.	20
61. Cooking stove.—John Whiting, city of Boston.	20
62. Power loom take up motion.—John P. Comsin, Killingly, Conn.	20
63. Weavers' Harness.—John Blackman, Brooklyn, Conn.	20
64. Knob for doors.—E. Robinson, F. Draper and J. H. Lord, Mass.	20
65. Forming cloth without spinning.—J. Arnold and G. G. Bishop, Norwalk, Conn.	20
66. Ventilating and warming houses.—R. Mayo and R. Mills, city of Washington.	24
67. Friction matches.—Alonzo D. Phillips, Springfield, Mass.	24
68. Picking and breaking wool and cotton.—John Schley, Augusta, Georgia.	27
69. Preserving and exhibiting maps.—N. K. Lombard, jr. city of Boston.	27
70. Parlour and cooking stove.—Nicholas Smith, New Hampton, N. H.	27
71. Scythes.—Silas Lamson, Cummington, Mass.	29

## LUNAR OCCULTATIONS FOR JANUARY, 1837.

Calculated by S. C. Walker.

Day.	H <sup>r</sup> .	Min.		N.	V.
19	15	16	Im. 47 Geminorum, 6,	147	207
19	15	36	Em.	181	240
20	12	57	Im. $\omega^1$ Cancrī ,6,	110	151
20	14	4	Em.	210	265
20	13	37	Im. $\omega^2$ Cancrī ,6,7,	57	108
20	14	57	Em.	263	321
23	8	34	Im. 42 Leonis ,6,	83°	32
23	9	41	Em.	263°	183
29	16	6	Im. 2 Libræ ,5,6,	43	15
29	17	18	Em.	250	237

## Meteorological Observations for September, 1836.

Moon.	Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sur. P.M.	2 P.M.	Sur. P.M.	2 P.M.	Direction.	Force.		
☾	1	69°	68°	29.86	29.65	SW.	Moderate.	.24	Clear—cloudy.
	2	54	68	29.90	30.10	NE.W.	do.		Clear do.
	3	60	74	29.90	30.00	SW.	Brisk.		Cloudy—flying clouds.
	4	63	78	29.91	29.90	SW.	do.		Lightly cloudy—do.
	5	68	64	29.90	29.90	SW.	Moderate.		Cloudy—bunder—rain.
	6	30	62	30.10	30.05	NE.	Brisk.		Clear do.
	7	52	64	30.10	30.15	E.	do.		Clear ko.
	8	54	69	30.03	30.05	NE.E.	Moderate.		Cloudy—flying clouds.
	9	60	77	30.00	30.06	S.W.	do.	.4	Drizzle—clear.
	10	62	63	30.00	30.05	NE.E.	Brisk.		Cloudy—cloudy.
	11	61	70	30.00	30.00	N.W.W.	Calm.		Cloudy—do.
☼	12	61	76	30.00	30.00	W.	do.		Fog—flying clouds.
	13	65	82	30.00	30.10	W.	Moderate.		Fog—clear.
	14	70	80	30.15	30.15	S.	do.		Fog—flying clouds.
	15	71	77	30.15	30.15	NE.	do.		Fog—flying clouds.
	16	68	73	30.15	30.15	E.	do.		Fog—highly cloudy.
	17	66	78	30.04	30.00	SE.W.	do.		Cloudy—do.
☾	18	68	83	29.90	29.90	SW.	do.		Cloudy—highly cloudy.
	19	74	83	29.90	29.90	SW.	do.		Fog—Clear
	20	72	86	29.80	29.90	W.	do.		Fog do
	21	66	71	30.03	30.06	NE.E.	do.	.2	Clear do
	22	65	70	30.06	30.00	E.SE.	do.	.5	Rain do
	23	70	84	29.90	29.85	SE.	do.		Cloudy—rain.
	24	68	78	29.90	29.90	SE.	do.		Heavy Fog—Clear
	25	60	64	29.80	29.90	N.W.	Brisk.		Fog—flying clouds.
	26	46	62	30.10	30.00	W.	do.	.30	Clear do
	27	52	62	29.70	29.55	SW.	do.	.60	Rain—flying clouds.
	28	56	61	29.65	29.75	NE.W.	do.		Clear—highly cloudy—rain in m.
	29	47	49	29.65	30.04	NE.W.	do.		Cloudy do
	30	36	60	30.04	30.04		do.		Clear do.
☾	Mean	60.73	71.53	29.95	29.95			1.25	

Thermometer.

Barometer.

Maximum height during the month 86. on 20th.

30.15 on 7th, 14th, 15th, 16th.

Minimum do. 36. on 30th.

29.50 on 28th.

Mean do. 66.14.

29.95.

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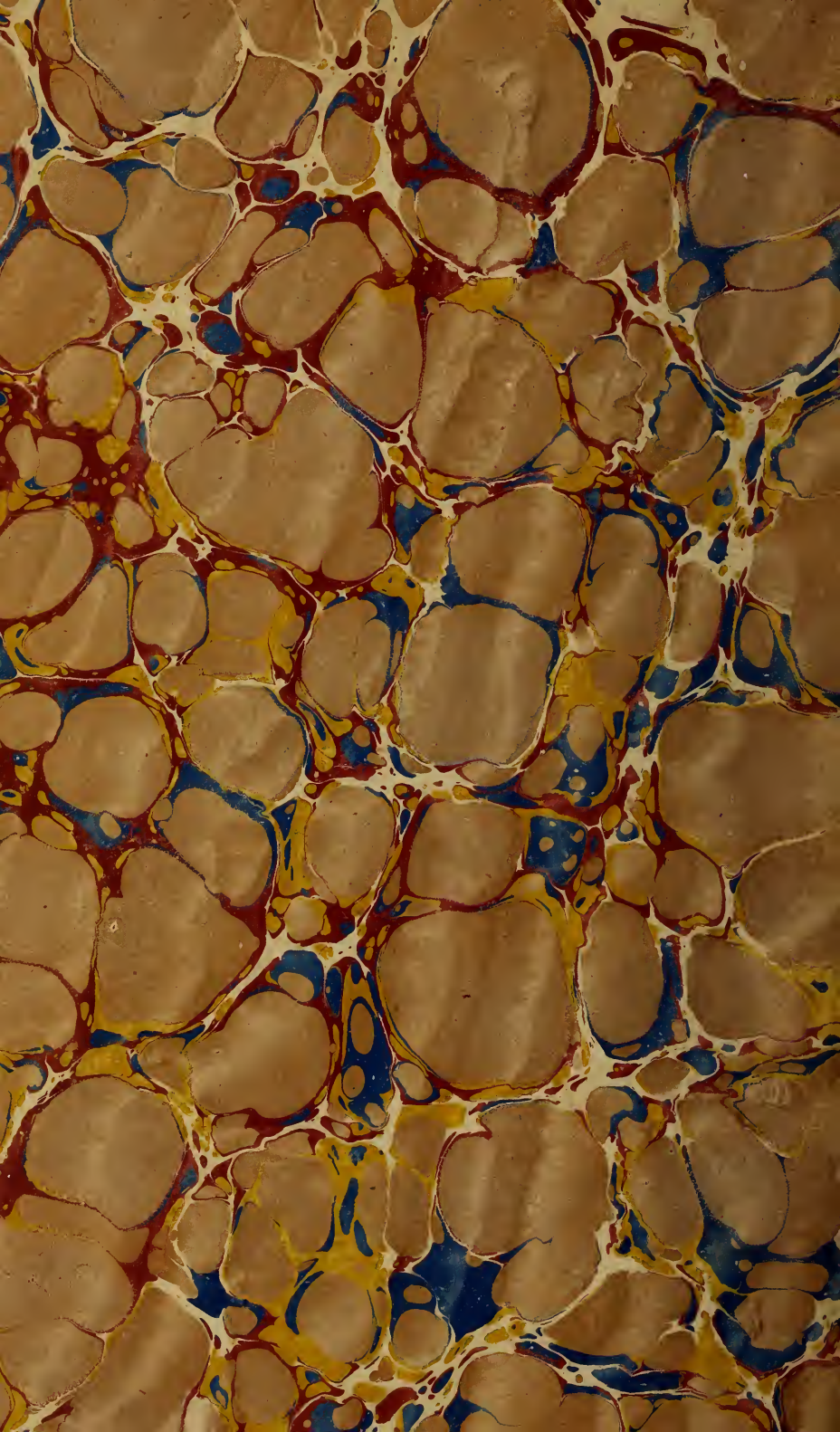


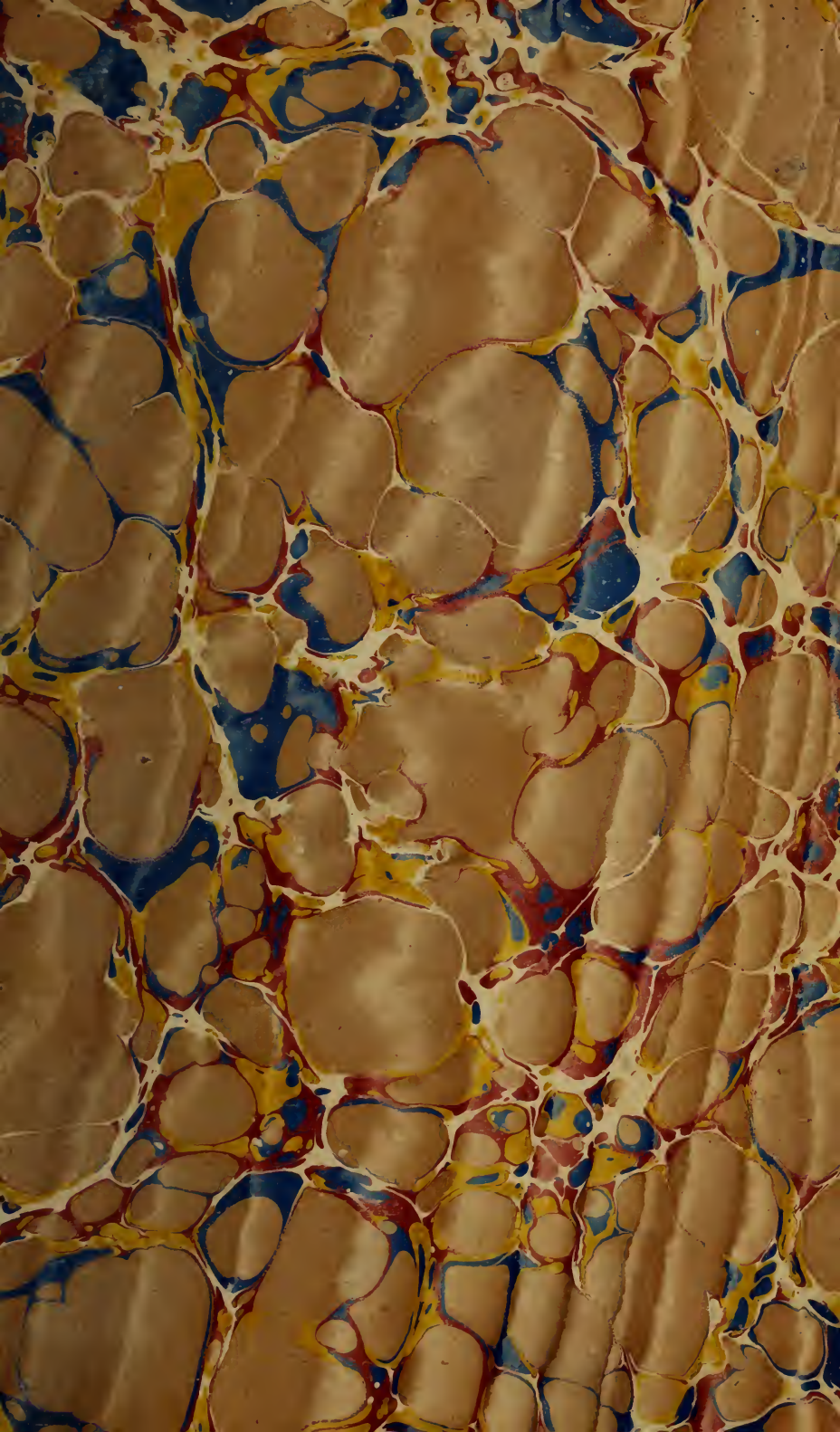




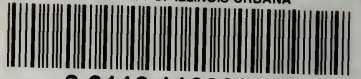








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